UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF OHIO
WESTERN DIVISION

Mary Piskura, et al.,

Plaintiff,

v.

Civil Action No. 1:10-cv-00248

Judge Herman J. Weber

TASER INTERNATIONAL, INC., et al.,

Defendants.

DECLARATION OF DARKO BABIC

I, Darko Babic, being of legal age and under the penalties of perjury, state as follows:

1. I am a competent adult and have personal knowledge of the following facts, or believe them to be true based on information and belief. Facts about which I do not have personal knowledge are of the type reasonably relied upon by experts in this field and have probative value to me in rendering my opinions.

2. Attached hereto is a true and accurate copy of my expert report in the above captioned litigation.

3. The report summarizes my analysis and findings and includes a statement of my opinions. The report also includes data and other information considered by me in forming my opinions and sets out my qualifications (including my resume).

4. My opinions are expressed to a reasonable, or higher, degree of professional certainty and/or probability.

5. I affirm under the penalties of perjury that the foregoing statements are true and correct.

October 31, 2011
Date

Darko Babic
Darko Babic

EXHIBIT
7

Failure Analysis Associates

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Piskura v. TASER International Inc.

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Piskura v. TASER International Inc.

Prepared for:

Michael Brave, Esq.
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October 31, 2011

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Brief Summary of Opinions

Based upon multiple independent forensic analyses no intact completed electrical circuit was initiated or maintained from the TASER® X26™ Electronic Control Device (ECD) deployed in probe mode toward Mr. Kevin Piskura by Oxford Police Department Police Officer Geoffrey Robinson on April 19, 2008. Thus, no electrical discharge was delivered to Mr. Piskura from the TASER X26 ECD.

Standard of Review

All statements and opinions herein are to a reasonable, or higher, degree of engineering, professional, and/or scientific certainty and/or probability.

Introduction

At the request of Mr. Michael Brave of TASER International, Inc. (TASER), I have investigated an incident involving Mr. Kevin Piskura. On April 19, 2008, Mr. Piskura allegedly attended the homecoming weekend at the University of Miami, Oxford, Ohio, and was in attendance at the Brick Street Bar in Oxford. The alleged incident took place after Mr. Piskura was escorted out of the Brick Street Bar by security personnel. Officer Geoffrey Robinson responded to the reported disturbance and allegedly subjected Mr. Piskura to the discharge of a TASER X26 Electrical Control Device (ECD). Thereafter, Mr. Piskura reportedly became nonresponsive and was attended to by emergency medical personnel. He was then transported to a local hospital from which he subsequently was air lifted to a trauma center where he passed away on April 24, 2008.

Bases for Opinions

I am a Manager with Exponent Failure Analysis Associates (Exponent), where I specialize in the engineering analysis of structural, dynamic, and materials issues, with specific expertise and experience investigating material behavior under various conditions including electrical arcing, as well as product design and various system issues. I have a Bachelor of Science in

Mechanical Engineering and a Master of Science in Materials Science and Engineering, both from the Arizona State University. I recently served as a Chairman of the Arizona Chapter for American Society of Materials International, responsible for providing information to the public related to structural and materials issues. In addition, I peer review scientific papers for various journals and societies including the Journal of Testing and Evaluation and the Society of Automotive Engineers. I served on the American Society of Mechanical Engineers Committee for High Pressure Piping Code B31.3, responsible for ultra high purity high-pressure system design, safety, and testing requirements, and material selection.

Using optical microscopy and scanning electron microscopy (SEM), I have personally examined more than 100 TASER ECD probes subjected to various electrical discharge durations when the circuit was completed between the barbed probes. Also, using a surface profilometer capable of detecting and characterizing the unevenness of a surface, I evaluated the changes in surface morphology for various delivered discharge durations. These technologies and forensic analyses are generally accepted in the fields of mechanical, materials, and electrical engineering.

Attached, as Appendix A, is a true and correct copy of my curriculum vitae. I am over 18 years of age. A list of cases in which I have provided expert testimony over the past 5 years is attached as Appendix B. Exponent currently charges $300 per hour for my consulting services.

My opinions in this matter are based upon the following and are to a reasonable, or higher, degree of scientific certainty and/or probability:

1) My education, training, and experience.

2) My evaluation of Piskura incident case materials, including fact witness depositions, ECD TASER Cam™ video and still frames, various reports, and the plaintiff's demand .

3) My inspection of the subject TASER X26 ECD including the metal probes and wires that were reportedly dispatched towards Mr. Piskura.

I may have supplemental opinions after further discovery process provides additional details about the allegations and the foundations upon which the plaintiffs based their allegations.

Case-Specific Materials Reviewed

The following Piskura case/incident specific materials were reviewed and considered in forming my opinions that are set forth in this report:

1. Complaint, April 19, 2011
2. Deposition of Officer Geoff Robinson, June 6, 2011
3. Deposition of Chief Schwein, June 7, 2011
4. Deposition of Mary Piskura, December 2, 2010
5. Deposition of Kathleen Piskura, December 2, 2010
6. Deposition of Charles Piskura, December 2, 2010
7. Deposition of Casey Burns, November 29, 2010
8. Deposition of Mark Weisman, November 29, 2010
9. Deposition of Devin Dickens, November 30, 2010
10. Deposition of Johnny Smith, E.M.T., November 30, 2010
11. Deposition of William Weisman, November 30, 2010
12. Deposition of Obinna Ugwu, M.D., December 1, 2010
13. Deposition of Barbara Aker, December 2, 2010
14. Deposition of John Jones, March 14, 2011
15. Deposition of Adam Price, March 14, 2011
16. Deposition of David Coffey, March 15, 2011
17. Deposition of Nathan Kron, March 15, 2011
18. Deposition of Steven Horn, M.D. March 16, 2011
19. Deposition of Matt Clayton, June 6, 2011
20. Deposition of Martha Craft, June 7, 2011
21. Deposition of Steven Smith, June 8, 2011
22. Deposition of Lauren Stenger, June 8, 2011
23. Deposition of Matt Stenger, June 8, 2011
24. TASER Initial Disclosure Statement, August 27, 2010
25. Plaintiff Disclosure Statement, August 27, 2010
26. Plaintiff Response to 1st Interrogatories, October 2, 2010
27. Plaintiff Response to 1st Request for Production, October 2, 2010
28. Police Department Incident Report, April 19, 2008
29. Police Department Report of Investigation, by Captain McMahon, June 24, 2008
30. Internal Investigation Report Notebook, June 26, 2008
31. Coroner Autopsy Report, September 9, 2008
32. Death Record, September 3, 2008
33. TASER Analysis Report by Andrew Hinz, April 30, 2008
34. Oxford Fire Department Report, April 19, 2008
35. Air Care & Mobile Care Medical Records, April 19, 2008
36. University Hospital Record, April 19, 2008
37. McCullough-Hyde Memorial Hospital Record, April 19, 2008
38. McCullough-Hyde Memorial Hospital Imaging Report, April 19, 2008
39. Kevin Piskura's Pediatric Records, UPCP Pediatricenter Record
40. Village of Walton Hill Employee Record

41. Miami University Employment Record
42. Stryker Endoscopy Employment Record
43. Gregory Baeppler Expert Report, September 9, 2011
44. Burke Rosen Expert Report, July 27, 2011
45. E. Don Nelson Expert Report, September 1, 2011
46. Andrew Scott Expert Report, August 18, 2011
47. Michael Wogalter Expert Report, September 9, 2011
48. Douglas Zipes Expert Report, September 6, 2011
49. TASER Cam Video – Robinson Deployment, April 19, 2008

Exhibits

All information, any and all of the underlying foundational or support materials and documents, and/or any portion thereof within this document or any of its references or attachments are to be considered important exhibits with regard to this case and this report. All photos, probes, wires, analyses, PDF files, images, videos, recordings, testing, methods, procedures, etc. are all to be considered exhibits that are hereby fully incorporated and an integral part of this report and may be used at any time during any aspect of proceedings associated with this case including, but not limited to, deposition and/or trial as exhibits to aid in my testimony, presentation, explanation, or for any other purpose.

Background

According to an Oxford Police Department (OPD) statement issued for immediate release at 4:30 PM on April 19, 2008 by OPD Public Information Officer (PIO) Sgt. Squance, an OPD Bicycle Patrol Officer, later identified as Officer Geoffrey Robinson, responded to a disturbance outside the Brick Street Bar at approximately 2:05 AM on April 19, 2008. Officer Robinson reportedly observed Mr. Steven Smith in a physical altercation with Brick Street employees, called in to report the fight to Dispatch, and attempted to arrest the "combative" Mr. Smith. When Officer Robinson moved to attempt to subdue Mr. Smith, Mr. Kevin Piskura reportedly intervened, resisting and struggling with both Officer Robinson and bar employees. Officer Robinson reportedly warned both Mr. Smith and Mr. Piskura to quit fighting and gave repeated warnings of the TASER ECD. Mr. Smith complied with the warnings, but Mr. Piskura continued fighting, and Officer Robinson attempted to "delivered one TASER ECD deployment" to Mr. Piskura's upper chest. Mr. Piskura reportedly fell to the ground and was

handcuffed. Other OPD units then arrived at the scene and noted that Mr. Piskura had "labored" breathing. The Oxford Life Squad subsequently responded, treated Mr. Piskura, and transported him to the local hospital.

Mr. Piskura's body was autopsied on April 25, 2008, by Deputy Coroner Obinna Ugwu, M.D., at the Hamilton County Morgue. At the time of autopsy, the decedent was status post multiple organ harvest, and a recently sutured incision was noted extending along the midline from the sternal notch to the pubic symphysis. At a location described as sixty-one inches (61 in) above the sole of the right foot and half-an-inch (0.5 in) to the right of the aforementioned midline incision of the anterior torso, Dr. Ugwu reportedly noted a two-inch by a quarter-inch (2 in × 0.25 in) diagonally oriented area of pale, denatured/excoriated skin that contained two quarter-inch (0.25 in) "oval, reddish brown abrasions" consistent with TASER ECD application. In his deposition, Dr. Ugwu testified that the TASER ECD probe had completely penetrated the epidermis and dermis but had not made it fully through the fat layer under the dermis. He further testified that he looked for but did not find a second TASER ECD probe mark on Mr. Piskura's body. Dr. Ugwu testified that he was "definitely not" an expert in "TASER probe signature marks."

The case materials received to date provide conflicting information in regards to where the TASER ECD probes allegedly struck or contacted Mr. Piskura. According to the statement provided by Officer Robinson after the subject incident, he shot the TASER ECD probes towards the chest of Mr. Piskura who fell backwards and began rolling. In his subsequent deposition, Officer Robinson estimated that he was standing between a foot and a half and two or three feet from Mr. Piskura when he deployed the TASER ECD probes. He further testified that he pulled the TASER ECD trigger once, and that he, based on watching the video of the subject incident, discharged it between nine and eleven seconds. The TASER X26 download shows a single discharge of eleven (11) seconds. Officer Robinson expected that the TASER ECD would cause Mr. Piskura to fall to the ground and "stop and be locked up," but instead he observed how Mr. Piskura, after falling to the ground, rolled at least two complete revolutions with the TASER ECD wires wrapping around his body. Mr. Daniel Kosmer, a witness to the subject incident, stated that Mr. Piskura was shot in the back with the TASER ECD as he was

"crawling" away from the scene. OPD Detective Jones, who responded to the scene of the subject incident, stated that he noticed that the TASER ECD probes were "stuck" in Mr. Piskura's chest area, and that the probes came out when he subsequently removed Mr. Piskura's shirt. Detective Jones subsequently testified in deposition that one probe was stuck in Mr. Piskura's upper right chest area, and that the other probe "did not appear to be in his skin, just in his clothing" in his "lower left region, abdominal area." Detective Jones further testified that the probe that was stuck in the chest area came out when he removed Mr. Piskura's shirt, and that the other probe was loose and "just appeared to be up against [Mr. Piskura's] shirt." Officer R. Sikora, who was working at the hospital emergency room (ER) when Mr. Piskura was taken there following the subject incident, reportedly advised that he observed two prong marks in the center of Mr. Piskura's chest "about 5 or 6 inches" apart. Medical records from Dr. Steven Horn from the emergency department of the McCullough-Hyde Memorial Hospital described "2 puncture wounds over his lower left sternum which were apparently from the TASER ECD barbs." However, Dr. Horn testified at his deposition that he had no independent recollection of any wounds on Mr. Piskura. He read from his notes which indicated that Mr. Piskura had two puncture wounds over his lower left sternum. There were no reports or notes of TASER ECD barbs being present in any of the puncture wounds and Dr. Horn has no knowledge of how far any TASER ECD probes penetrated into Mr. Piskura. Dr. Horn also testified that he is not an expert on TASERs.

In his report, Plaintiff expert Dr. Douglas Zipes speculates that the midline longitudinal incision that was done to harvest Mr. Piskura's organs prior to autopsy could have obliterated a probe mark and thus be the explanation to why Dr. Ugwu only found one probe mark at the time of autopsy. No evidence was observed to support such claims by Dr. Zipes.

Review of ECD Operation and Metal Probes

Review of ECD Operation

Handheld TASER Electronic Control Devices (ECDs) are commonly used by law enforcement and military. A handheld TASER ECD consists of a handle portion that generates the electrical discharge pulses and a cartridge portion that, when the ECD achieves an intact completed

electrical circuit delivers the electrical energy to a subject. The tip of the unit is designed such that a cartridge can be attached to it mechanically, but also so that electrical continuity can be established between the unit and the cartridge[1]. An ECD cartridge contains metal probes, each of which are typically attached to 20 to 35 feet of folded, small diameter insulated wire. The wires attach at the other end to the cartridge and thereby the ECD unit. When the unit is fired, the metal probes are propelled from the cartridge by means of pressurized gas stored within the cartridge. As the metal probes are propelled outward from the unit, the wires unfold and maintain electrical contact between the metal probes and the cartridge/ECD unit. As soon as the metal probes with pointed tips either penetrate the subject's skin, or come simultaneously into sufficiently close proximity to the subject's skin, an electrical circuit is established between the two (positive and negative) terminals on the unit, i.e. when in sufficiently close cumulative proximity to both metal probes the subject's body can provide the connection between the two probes, Figure 1.

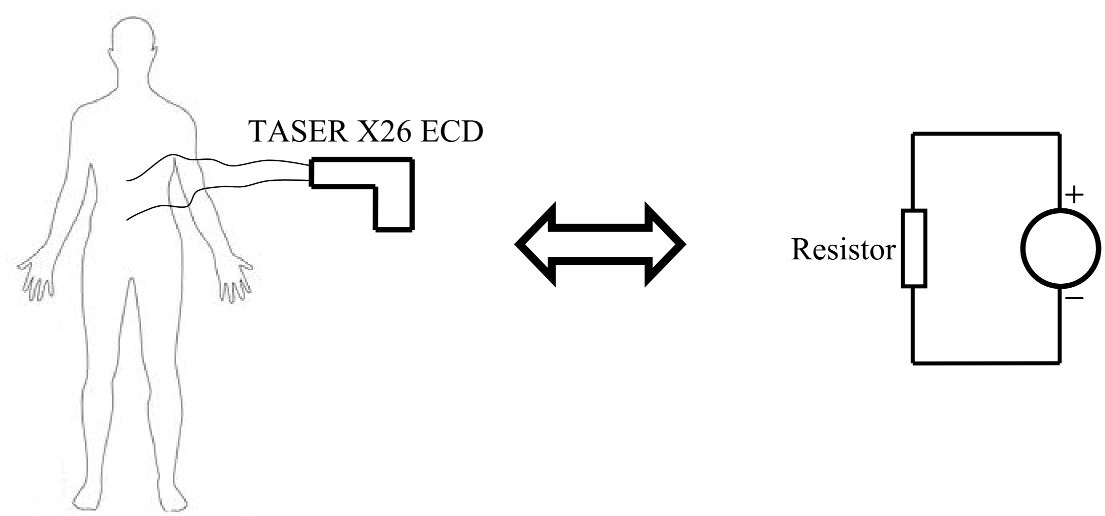

Figure 1. Simplified schematic of a human body connected to a TASER X26 ECD through the wires (metal probes not shown), and the equivalent electrical circuit depicting the electrical configuration of such completed circuit connection.

[1] A small air gap exists between the electrical contacts of the cartridge and the handle. The voltage is sufficient to enable the electrical discharge to bridge this air gap.

When in probe deployment mode, with sufficient probe spread, and intact electrical circuit established that includes the probes and the subject's body, an ECD is designed to deliver an electric current to a subject's body with the purpose of temporarily incapacitating the subject. Activation of the ECD trigger not only dispatches the metal probes from the cartridge, but it also delivers a burst of energy at the output of the unit and potentially to the subject. For example, a TASER X26 ECD is rated to deliver a 1,200 V peak pulse at an approximate pulse rate of 19 pulses a second with each pulse lasting less than 150 microseconds. With an electrical circuit established between the two metal probes and the subject's body the energy flows in and out of the subject's body through two thin insulated wires connected on one end to the two metal probes and on the other end to the cartridge/unit. The diameter of the metal wire with insulation is approximately 370 micrometers (370 millionths of a meter, or approximately 0.015 inches), while the diameter of the metal wire alone is approximately 0.127 microns (approximately 0.005 inches). The type of attachment utilized between the wires and the metal probes creates an air gap between the wire tip and the metal probe, which must be simultaneously bridged on both the positive and negative sides to complete and then maintain the electrical circuit. Due to the high voltage pulse, the air gap is bridged by an electrical arc which develops between the wire tip and the metal probe. This arcing activity results in visible changes (witness marks) to the wire tip and the surface of the metal probe exposed to the arcing. The presence of such surface morphology changes provides physical evidence indicating that the electrical circuit between the two metal probes was closed (an electrical circuit was established), and that energy was likely delivered to the subject's body.

Alternatively, the absence of such arcing witness marks on either or both of the two metal probes indicates that the electrical circuit was never closed (an electrical circuit was never established) between the metal probes, and that the energy released by the ECD therefore never reached the subject's body. In this latter case, the energy created by the ECD must go somewhere and most likely becomes discharged as an electrical arc between the two fixed electrodes at the tip of the ECD cartridge as long as the expended cartridge remains attached to the X26 ECD. This latter type of discharge would also occur if the probe electrical circuit becomes interrupted for any number of reasons, including the wire breakage. However, if the cartridge becomes dislodged from the X26 ECD, the electrical discharge would occur in the

form of an arc between the two fixed electrodes at the tip of the ECD, a so called “drive stun”. The ECD can also be used in “drive-stun” mode if an expended cartridge remains in place on the ECD and the front of the cartridge is placed in direct contact with the subject.

Figure 2. X26 ECD – Note the two fixed electrodes at the tip of the ECD unit. When a cartridge is inserted at the front of the unit, the cartridge also has two fixed electrodes. These allow the unit to be used in “drive-stun” mode after the cartridge had been expended.

When the probes are deployed, the X26 ECD automatically delivers a series of pulses for a minimum of 5 seconds. The operator can stop the ECD discharge at any time by engaging the safety. A subsequent trigger and quick release pull will generate an additional 5 seconds of stimulation. For trigger holds longer than 5 seconds, the ECD will deliver the pulses for as long as the trigger is actuated by the operator. It is important to note that the data logged in the X26 ECD only records the duration of the trigger pull. It does not indicate if the probes were a part of the electrical circuit (i.e. if the probes contacted the target), or if the circuit was actually completed or interrupted at any point during the discharge. The log also does not make a distinction between the “drive stun” and the probe mode.

Metal Probes and Arcing Location

A typical metal probe fired from the TASER X26 ECD is made out of nickel coated aluminum, Figure 3. It consists of the barb (a sharp, straight barbed projection similar to a fish-hook facing

left in Figure 3) attached to the tip of the cylindrical probe body. The bottom end of the probe body has a cylindrical longitudinal hole through which the wire is pulled. The wire is then pulled through a larger transverse hole where it is retained by a knot tied on the wire itself approximately three to four millimeters (mm) from the wire's tip. This knot prevents the wire from being pulled back through the smaller longitudinal hole. The tip of the wire is generally oriented towards the tip of the probe (typically between 10 and 2 o'clock when looking towards the tip of the probe and down at the transverse hole). For the purpose of analysis, by observing the orientation of the barb (facing left or facing right), it can be determined which side of the transverse hole (top or bottom) is being observed.

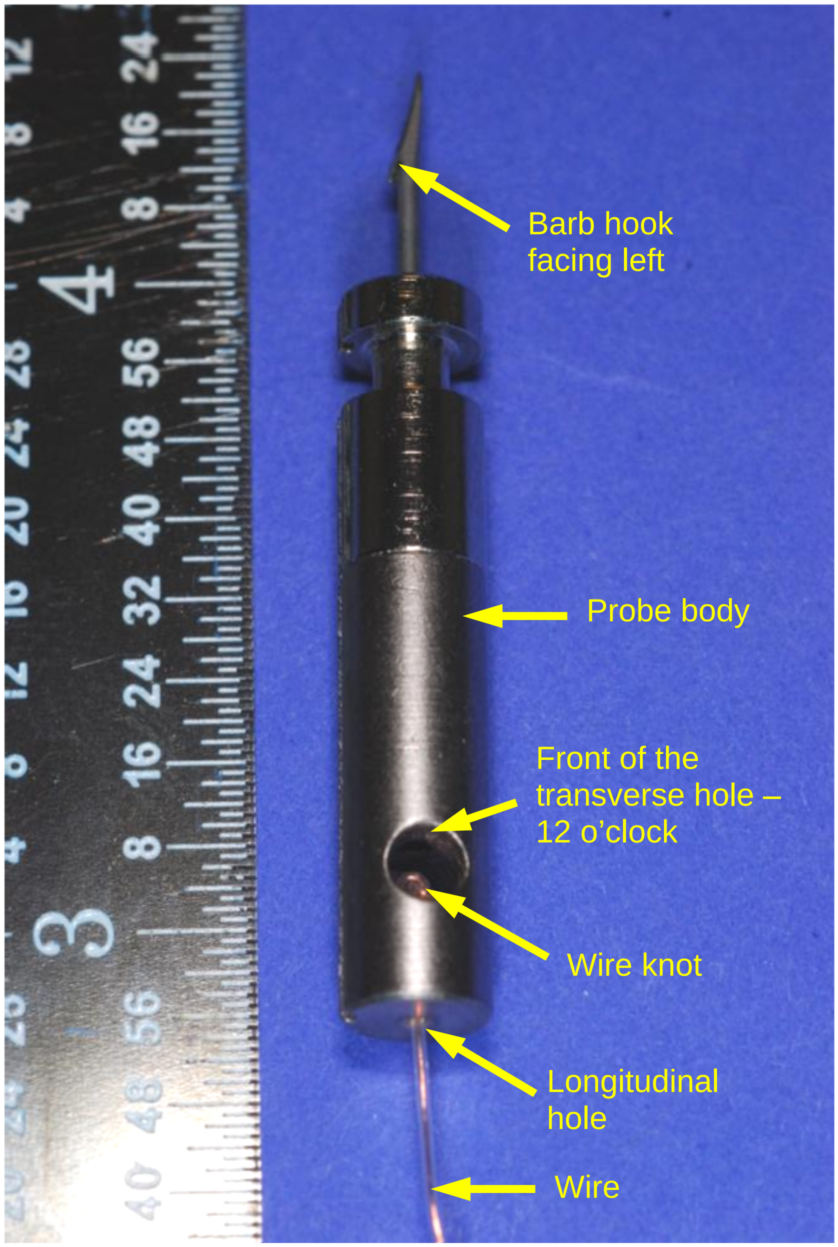

Figure 3. Typical TASER ECD metal probe used in X26 ECD. In this instance, the barb is turned to the left (hook facing left).

As mentioned earlier, electrical arcing occurs between the wire tip and the cylindrical surface of the transverse hole when the probes are a part of the intact ECD electrical circuit. Based on the typical orientation of the wire tip contained within the transverse hole, the area that most likely will experience arcing is located between 10 and 2 o'clock inside the transverse hole (closer to the tip of the probe which corresponds to 12 o'clock). Previous testing indicates that arcing can occur at various elevations (top, middle, bottom) within the transverse hole depending on the location of the wire tip, but that it always will be confined to the leading portion of the hole

surface.. During all previous testing, arcing has never been observed at the rear surface of the hole (closer to the bottom of the probe corresponding to 6 o'clock).

Wire Testing and Fracture Evaluation

Wires from several TASER ECD cartridges were tested to determine their strength and to evaluate the resulting condition of the broken wire in the Piskura case, especially the appearance of the wire tip. Wires from 35-foot and 25-foot cartridges were tested. The labeling of each sample (the sample ID) provides information about each wire's origin. For example, the sample identified as 1-25-2-L was taken from the first cartridge (first digit), the cartridge had 25 feet of wire (second and third digits), the wire sample was the second one to be collected (fourth digit), and the sample was collected from the left chamber with folded wire (last position in the sample ID). The testing was performed at several loading rates to evaluate the effect of the loading rate on the ultimate wire load and wire/insulation condition at the fracture location. Slower loading rate tests were conducted on an Instron tensile frame with capstan grips, while the faster loading rate tests were conducted on an MTS Mini Bionix II tensile frame, also with capstan grips. Capstan grips were used to grab onto the wire without causing unrealistic stress concentrations at the grips, and thus to avoid underestimating the fracture force. Results of the wire tests are shown in Table 1 and Table 2.

Table 1. Wire testing results for slower load rates.

Sample ID	Initial Failure Load (lb)	Final Failure Load (lb)	Loading Rate (in/min)
1-25-2-L	1.64	1.29	0.039
1-35-2-L	1.73	1.53	1.97
2-25-2-L	1.63	1.44	1.97
2-35-4-R	1.74	1.70	1.97
3-25-4-R	1.51	1.27	1.97
3-35-2-L	1.68	1.47	1.97
Average	1.66	1.48	

Table 2. Wire testing results for faster load rates.

Sample ID	Initial Failure Load (lb)	Final Failure Load (lb)	Loading Rate (in/min)
1-25-1-L	2.00	1.07	174.6
2-25-4-R	1.92	1.04	174.6
3-25-2-L	1.96	1.00	174.6
1-35-3-L	1.99	1.04	174.6
2-35-5-R	2.08	1.13	174.6
3-35-3-L	1.99	1.07	174.6
Average	1.99	1.06	

It was observed that the ECD wires have distinct force – displacement graphs regardless of the loading rate, which can be seen in Figure 4, Figure 5, and Figure 6. The first peak in each graph is associated with the force needed to break the metal wire and to extend the insulation material for that break to occur. At the point of metal wire fracture, the force was transferred to insulation material only, thus the observed drop in force. After the metal wire had fractured and the force had dropped, the insulation continued to stretch until it finally fractured as well. Thus, the second peak was associated with the final fracture of the insulation material alone. Regardless of the loading rate, the force needed to fracture the insulation (second peak) was always lower than the force at which the metal wire fractured (first peak).

The data indicate that the force at which the metal wire fractured was fairly constant for lower loading rates and was approximately 1.6 pounds (lb). However, it was slightly higher at approximately 2 lb for the highest loading rate available (174.6 in/min). Considering instead the insulation material, the fracture force at the highest loading rate (approximately 1 lb) was lower than the corresponding force recorded in the slower loading rate tests (approximately 1.5 lb).

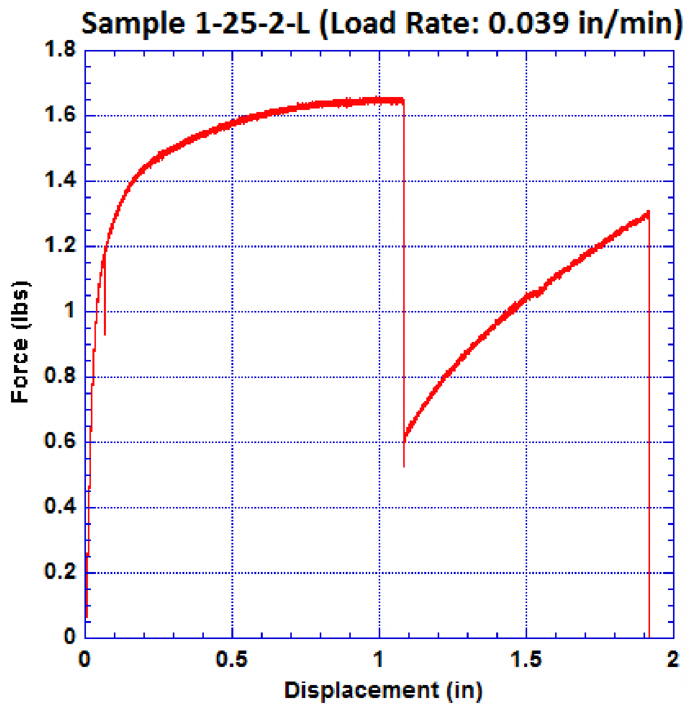

Figure 4. Force – Displacement graph for the wire tested at the lowest loading rate – 0.039 in/min.

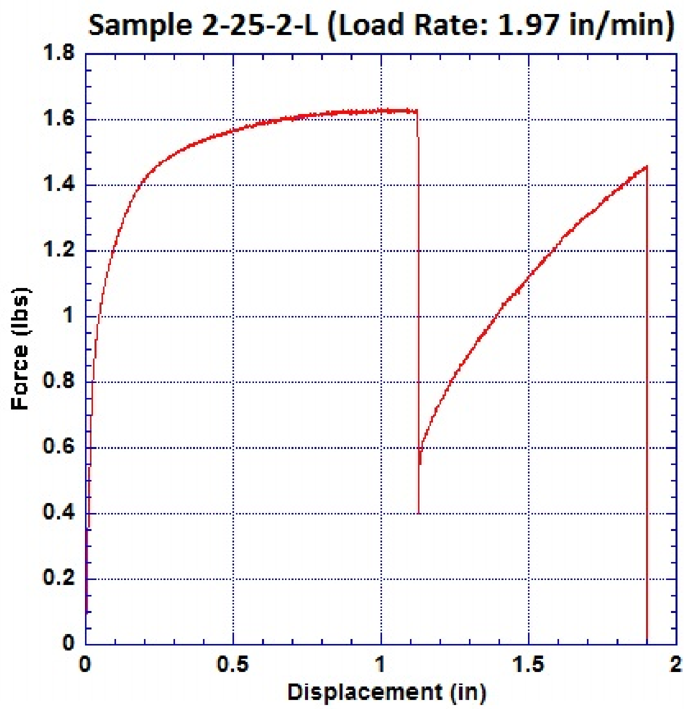

Figure 5. Force – Displacement graph for the wire tested at the intermediate loading rate – 1.97 in/min.

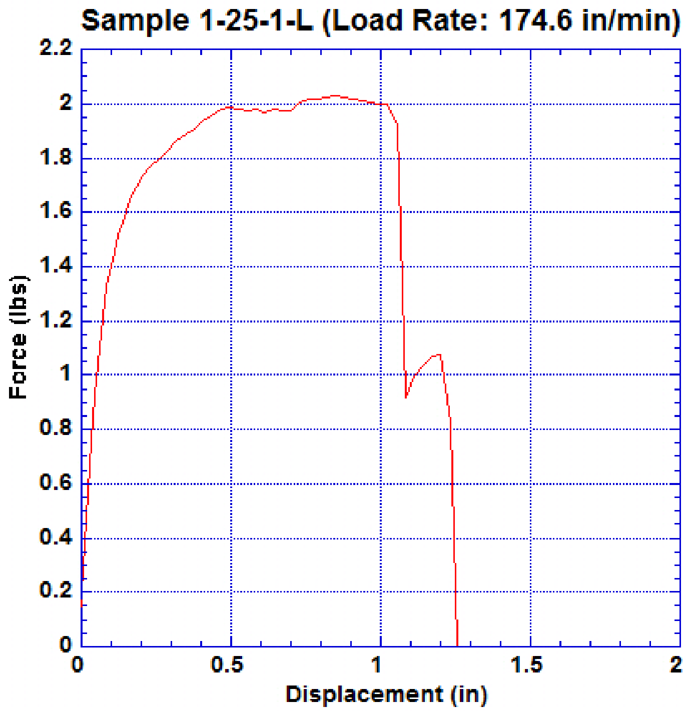

Figure 6. Force – Displacement graph for the wire tested at the highest loading rate – 174.6 in/min.

After each test, the broken wire ends were examined to observe their condition. In every test conducted, the insulation material had stretched and extended beyond the fractured metal ends at the fracture location (Figure 7, Figure 8). This prevented subsequent direct contacts with the metal wire from occurring. Thus, if the newly fractured ECD wire were to become a part of an electrical circuit capable of delivering an electric charge, the electricity would have to bridge the air gap created by the stretched insulation material. In other words, arcing would have to occur, and visible evidence of this would be created, such as melted insulation or charred material.

Although the ECD wire demonstrated some rate sensitivity, the fracture force remained low for this type of wire. Thus it is reasonable to assume that a wire could fracture if pulled or tugged while a person is struggling or rolling onto the wires. Such fractured wires are unlikely to complete an electrical circuit without leaving visible evidence in the form of arcing witness marks.

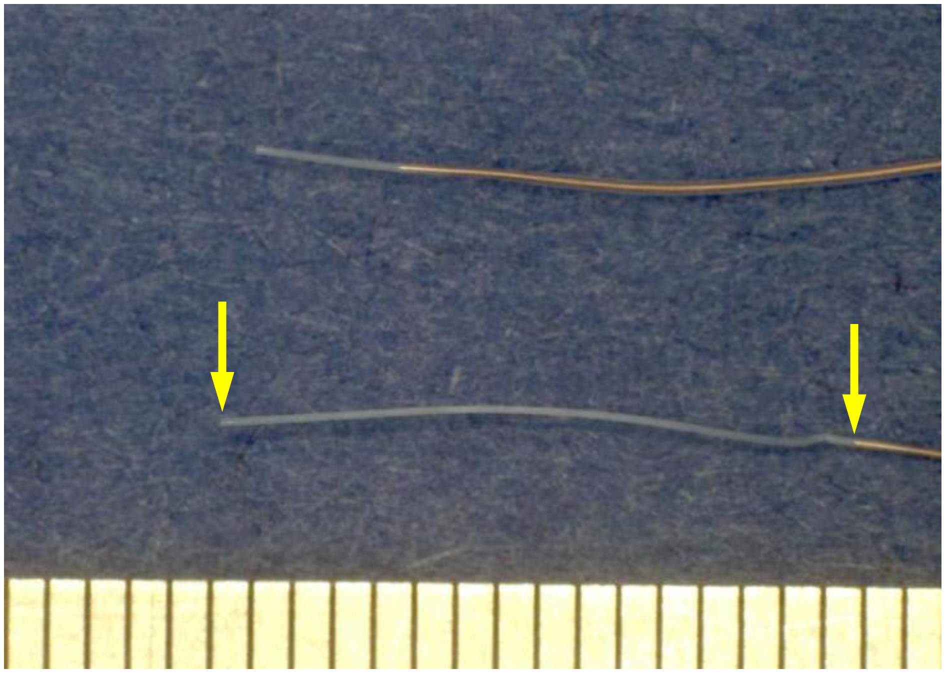

Figure 7. Condition of the broken wire ends for sample 1-25-2-L – slowest loading rate. Note the significant stretch of the insulation material (between the yellow arrows – millimeter scale at the bottom).

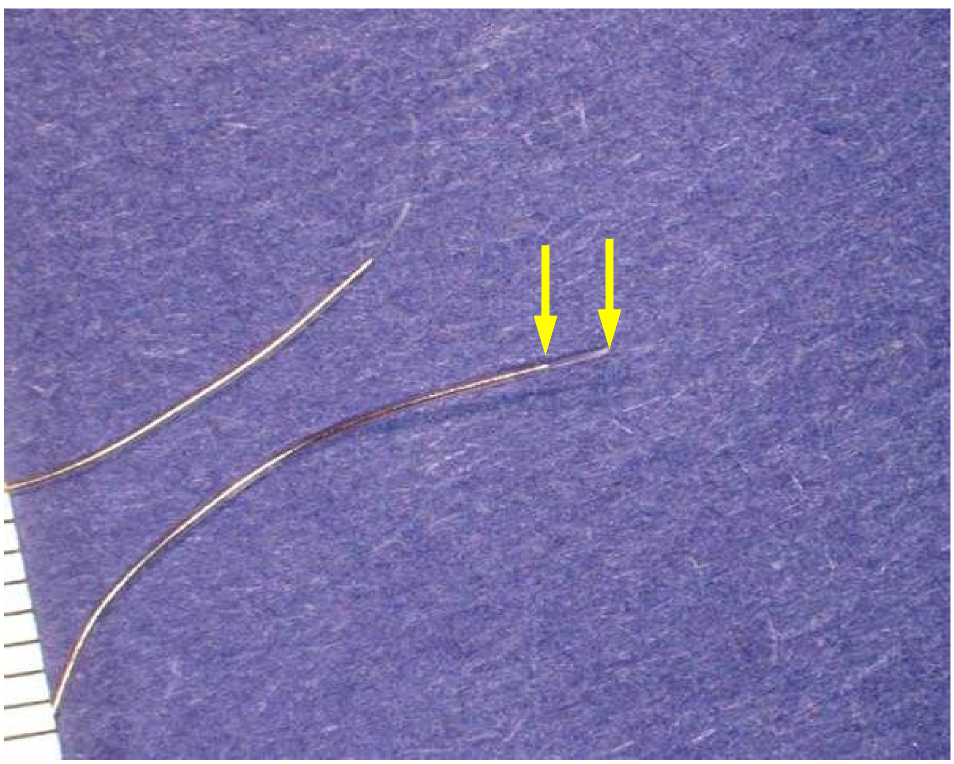

Figure 8. Condition of the wire tips for sample 1-25-1-L – highest loading rate. Note the less pronounced stretch of the insulation material (between the yellow arrows).

Study of Damage Induced on Metal Probes by ECD Discharge

Because ECD electrical arcs result in extremely hot gases of plasmas, typically over 10,000 degrees Fahrenheit, changes to the metal surface of the probes subjected to electrical arcing are to be expected. All the exposed probes displayed small, but visible differences to the surface morphology such as small pits, molten and re-solidified material, and microscopic craters. Such surface morphology changes (i.e. damage to the surface) can be used to not only establish that the electrical circuit had been completed between the wire tip and the surface of the probe, but also to relate the resulting damage to the electrical discharge duration.

I have evaluated more than 100 exemplar metal probes previously subjected to known ECD discharge durations of 5, 10, 15, 30, or 45 seconds. The examined exemplar probes were a part of an electrical circuit that was established either through living subjects or through a 600 Ω (ohm) resistor. No visible differences were observed between the probes discharged through the living subjects and the probes discharged through the 600 Ω resistor. The 600 Ω resistor was used because according to current literature it is the closest to actual human living subjects (Dawes DM, Ho JD, Kroll MW, Miner JR. Electrical characteristics of an electronic control device under a physiologic load: a brief report. Pacing Clin Electrophysiol. Mar 2010; 33(3):330-6.).

Optical microscopy, scanning electron microscopy (SEM), and surface profilometry were used in evaluating the tested probes. Optical microscopy aided in determining the general area within the transverse hole that was exposed to arcing. SEM was used to evaluate the changes in surface morphology and identify the areas where arcing had disturbed the surface of the hole. It is important to note that when performing SEM analysis, the wires (with knot) had to be removed from the probes since the polymeric wire insulation could charge the SEM and thus disrupt the analysis and obstruct the imaging. For this reason, optical analysis was made more efficient and clearer by removing the wires beforehand.

Initially, optical and SEM analyses were performed with the probes intact. Samples were tilted to allow the arc-affected surfaces within the transverse hole to be observed. However, it was subsequently determined that it could become difficult to access and evaluate the arcing area if

arcing had taken place deep within the transverse hole. To resolve this potential problem, a method was devised to section the transverse hole and thus allow for more direct access to the arcing area. Once the area of arcing was identified and documented without modifying the probes, the probes were marked for cutting in such a way that the cut did not disturb or destroy the arcing area (evidence). In general, the cutting removed the bottoms of the probes which allowed for direct access to the arcing area. For example, in Figure 11, two cutting surfaces that were created during the removal of the bottom of the probe are visible at the top and bottom of the image, however, the area of arcing was preserved and the evidence remained intact. Combining optical and SEM analyses allowed for reliable evidence identification as well as its preservation.

Although SEM analysis had already provided a general indication on the extent of arcing, induced surface damage, and its relation to the ECD intact circuit discharge duration, surface profilometry was also utilized to evaluate and quantify the extent of the disturbance in the areas exposed to arcing. Such coupling between SEM and surface profilometry analyses provided for the means to relate the surface morphology changes to the duration of ECD discharge in analyzed samples.

Surface profilometry was correlated with SEM images for each of the five tested discharge durations. From these SEM images, it was visually determined that shorter discharge durations produced less apparent damage to the surface of the transverse hole, while longer discharge durations visually produced more pronounced damage. Surface profilometry analysis also confirmed that the damage for shorter discharge durations was indeed less pronounced than the damage for longer discharge durations. Quantitatively, the measurements obtained using surface profilometry indicated that the volume of the disturbed material increased with an increasing discharge time in the analyzed samples.

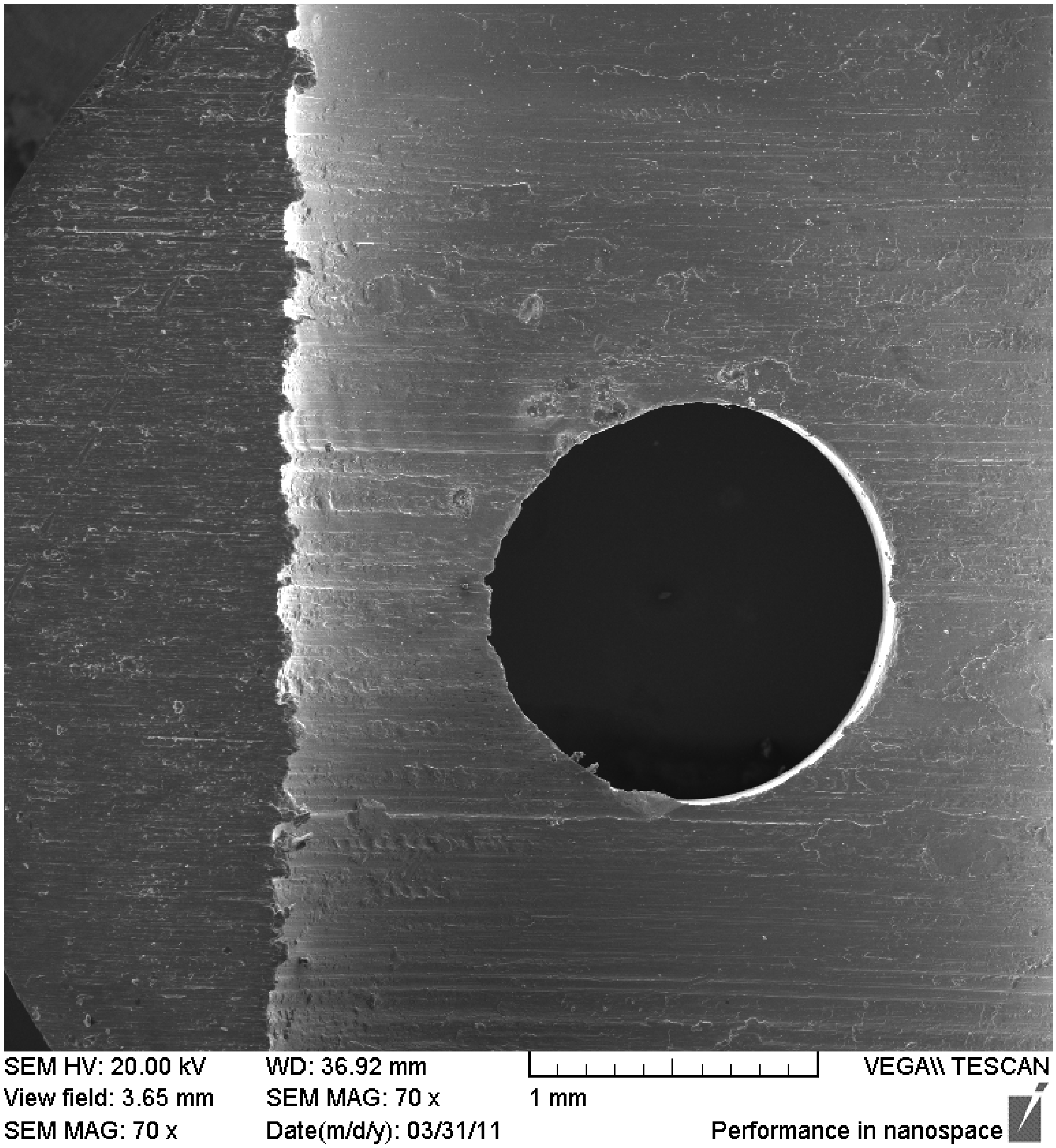

Figure 9. Surface appearance inside the transverse hole after a five (5) second discharge duration through the completed circuit. The transverse hole axis is vertical in this image, while the observed hole going into the paper is the smaller longitudinal hole.

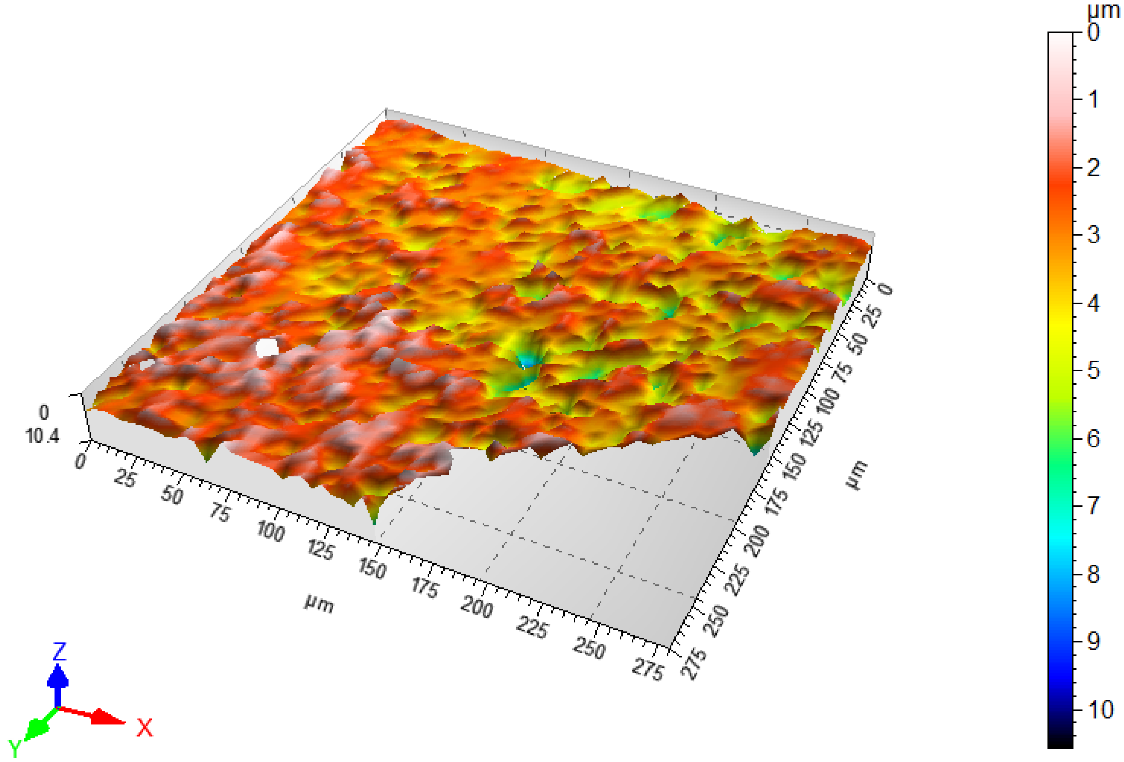

Figure 10. Surface profilometry measurement on the sample from Figure 9 – five (5) second discharge duration. The undisturbed areas are indicated by the reddish orange areas, while the deeper pitted sections are depicted by the blue-green areas. The color chart shows the depth of the depressions in the surface of the affected area.

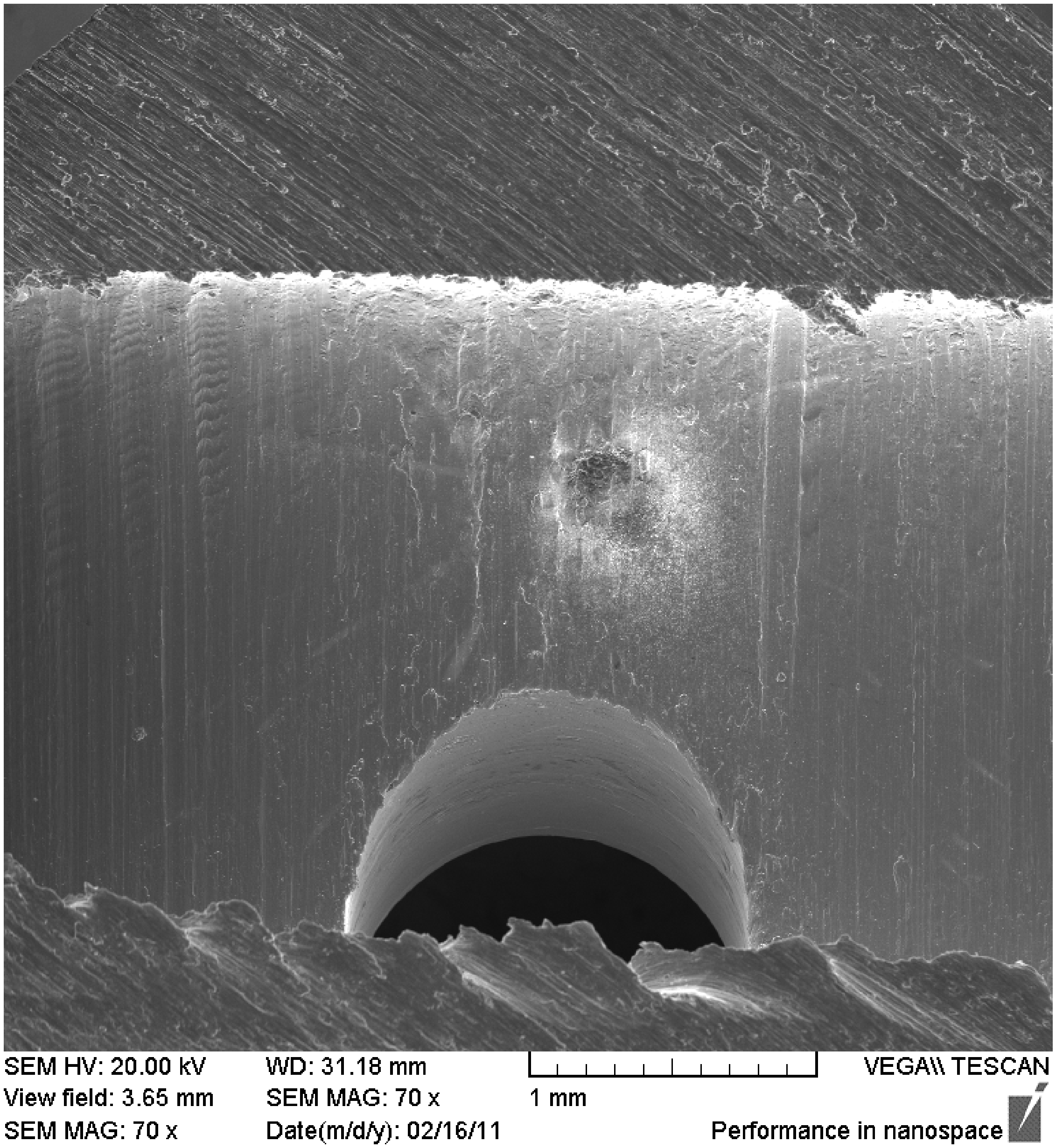

Figure 11. Surface appearance inside the transverse hole after a ten (10) second discharge duration. The obvious whitish pit shown just above the longitudinal half-tunnel is the damaged area. The long axis of the transverse hole is oriented approximately horizontally. Note the two surfaces at the top and bottom of the image, which were created by removing (cutting) the bottom end of the probe. Despite removing the bottom of the hole the evidence remained intact.

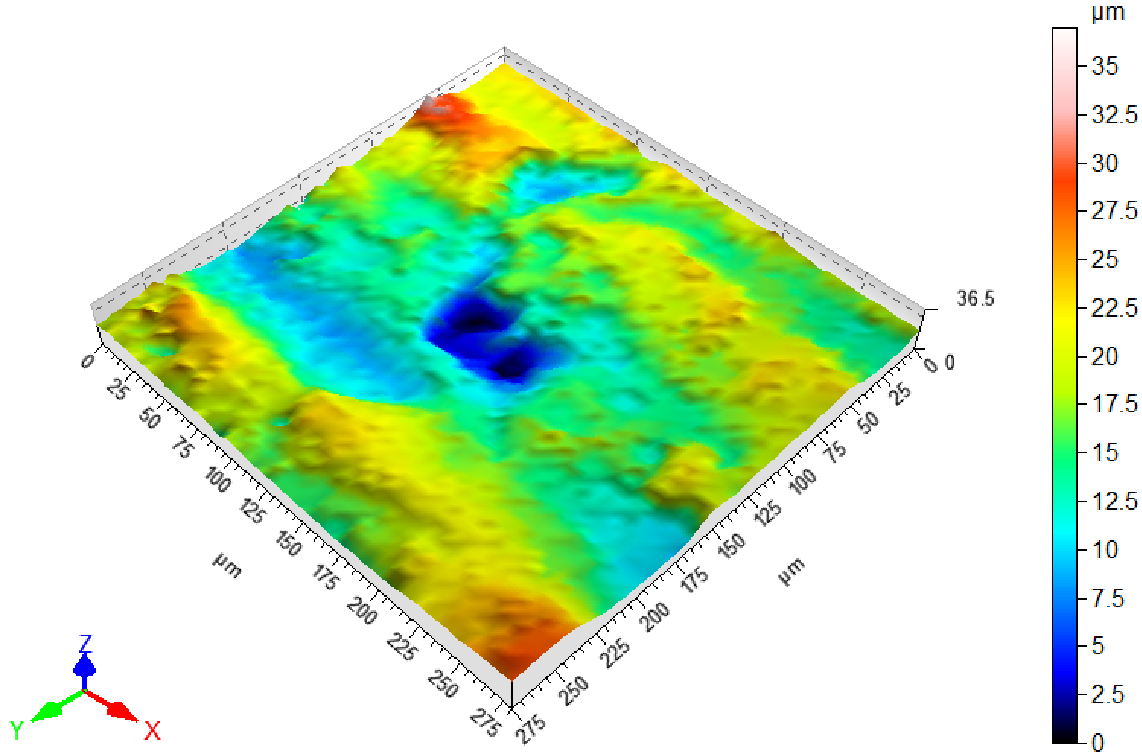

Figure 12. Surface profilometry measurement on the sample from Figure 11 – ten (10) second discharge duration. The pitted area is more than 20 micrometers deeper than the surface of the surrounding metal.

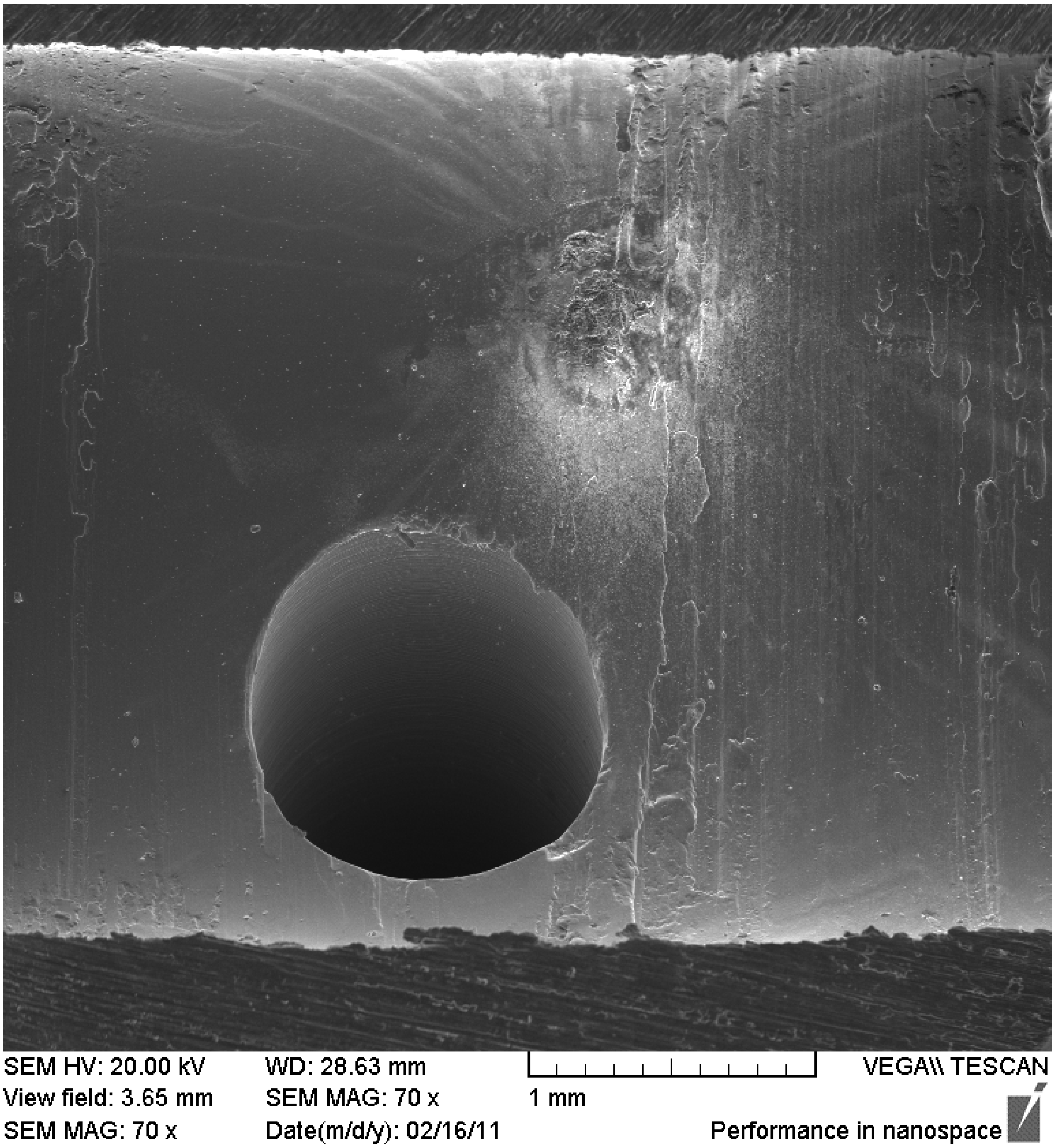

Figure 13. Surface appearance inside the transverse hole after a fifteen (15) second discharge duration.

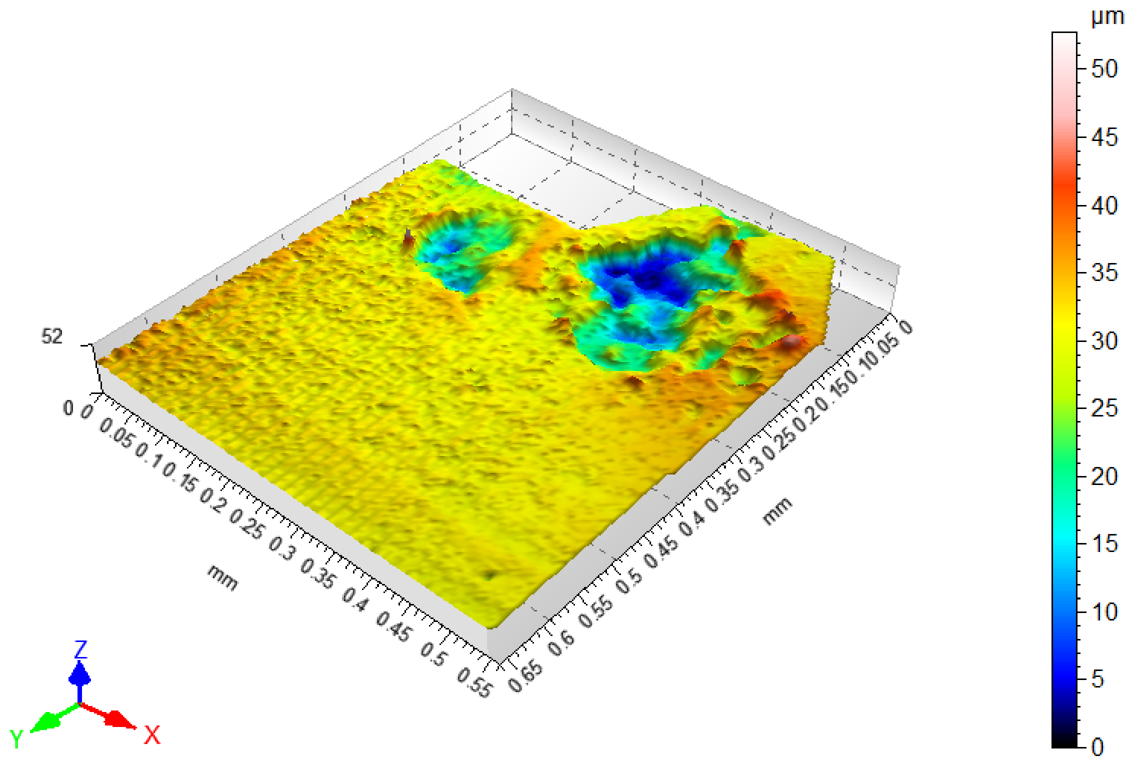

Figure 14. Surface profilometry measurement on the sample from Figure 13 – fifteen (15) second discharge duration.

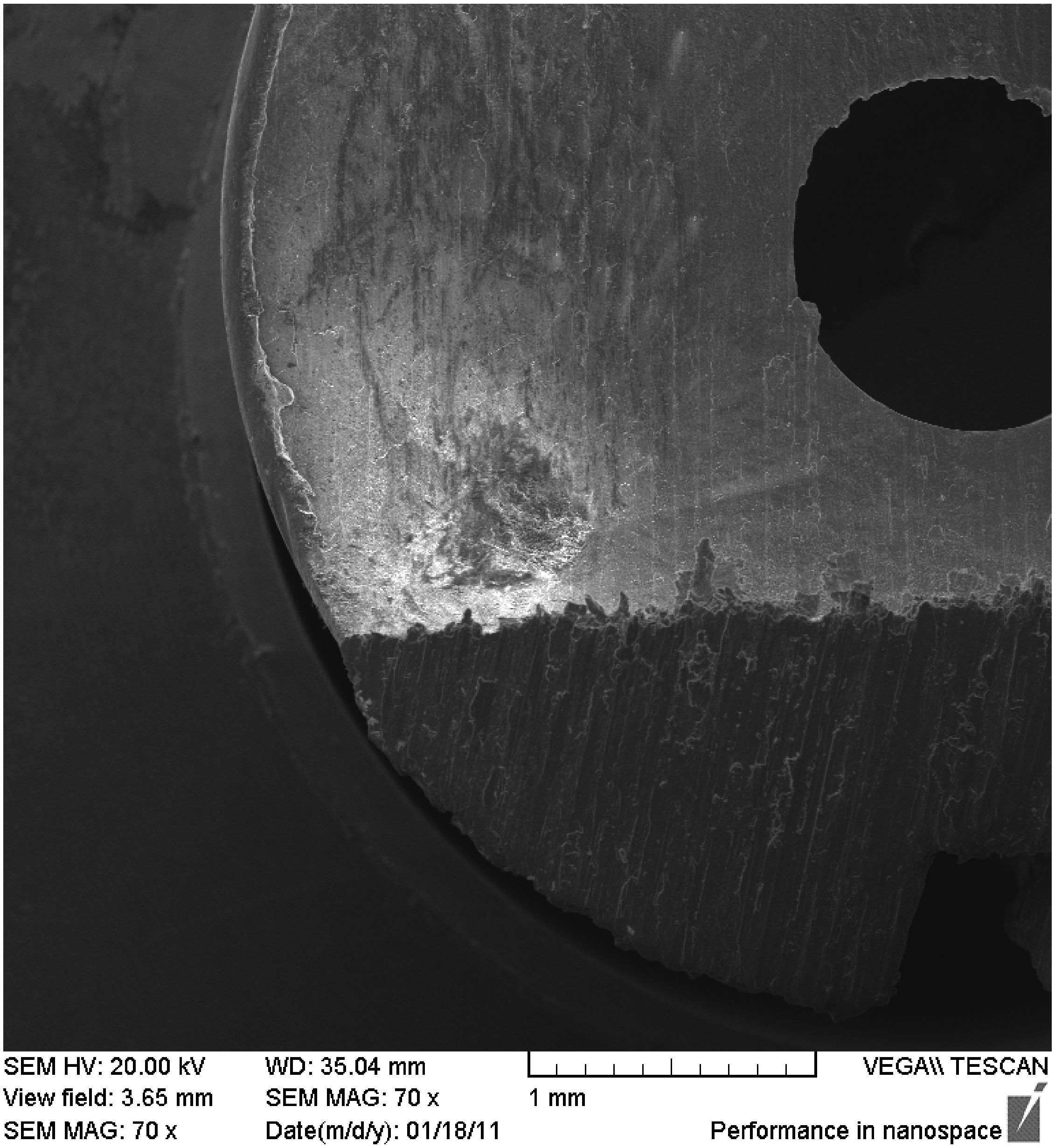

Figure 15. Surface appearance inside the transverse hole after a thirty (30) second discharge duration.

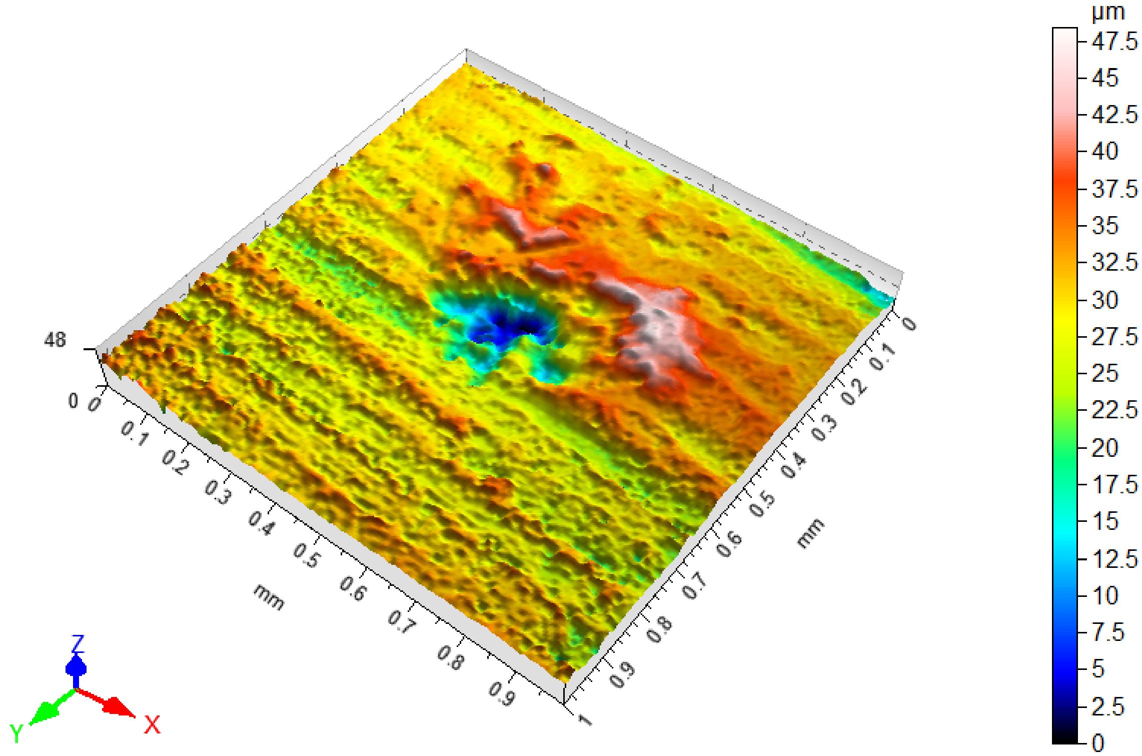

Figure 16. Surface profilometry measurement on the sample from Figure 15 – thirty (30) second discharge duration.

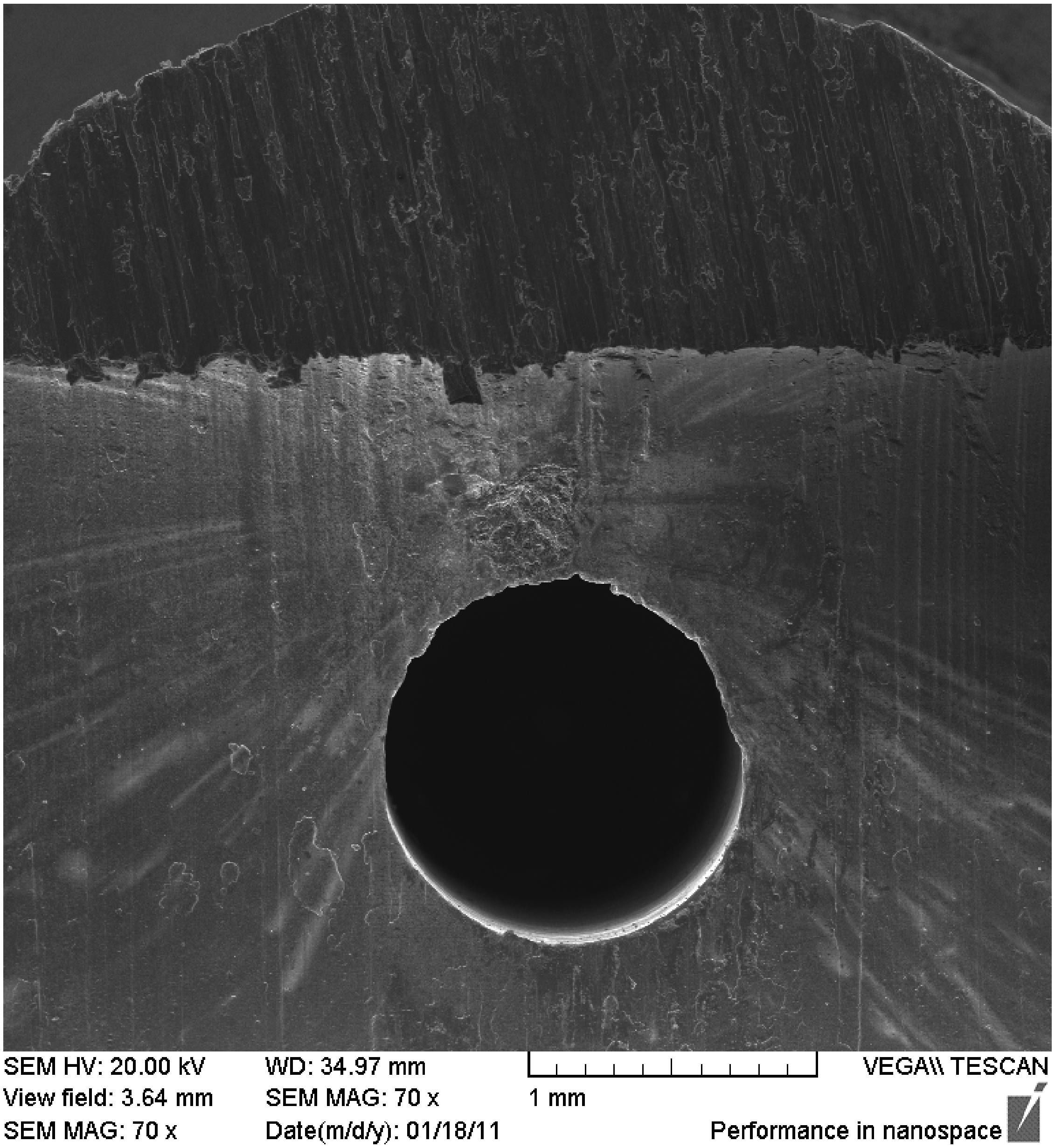

Figure 17. Surface appearance inside the transverse hole after a forty five (45) second discharge duration.

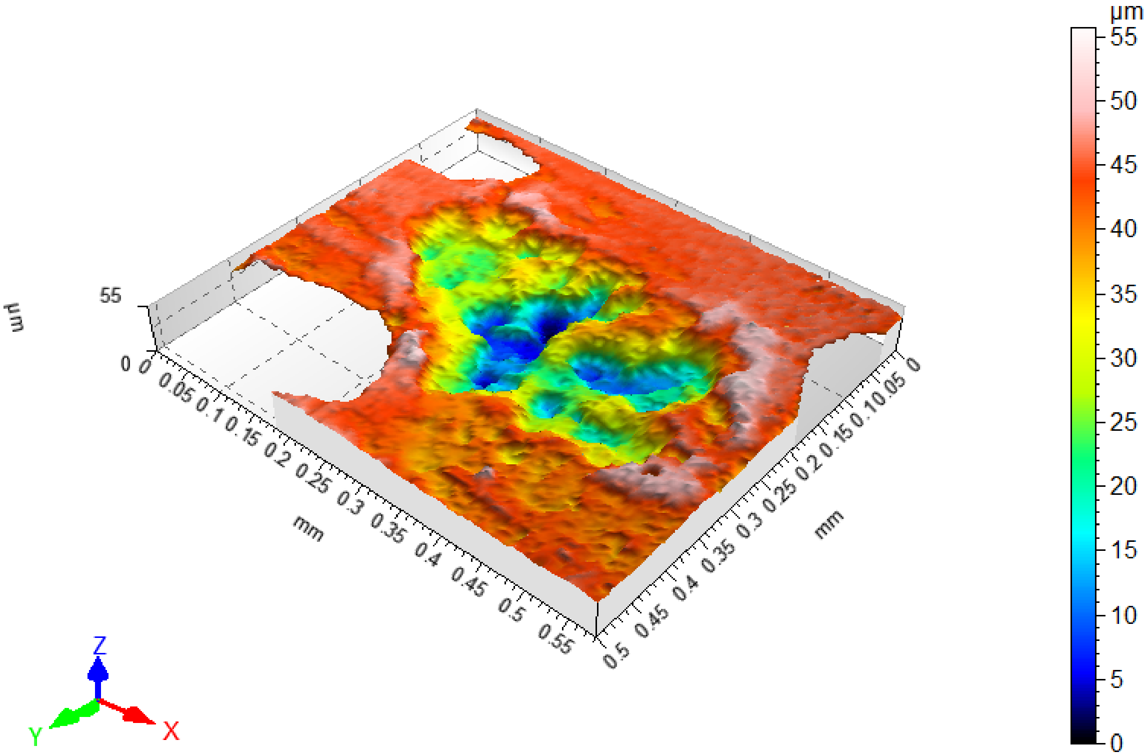

Figure 18. Surface profilometry measurement on the sample from Figure 17 – forty five (45) second discharge duration.

Surface profilometry measurements were performed over an area sufficiently large to encompass the area damaged by arcing. Upon data collection, the global curvature of the transverse hole was removed, i.e. the image was "flattened", and the area defining the changes in the surface morphology was selected. A reference plane was then fitted to everything else surrounding the area exhibiting arcing damage. Finally, the volume of the crater and the surrounding material peaks created during the arcing event were quantified. As shown in Figure 19, the extent of damage observed and quantified on the surface of the transverse hole is directly proportional to the duration of intact circuit ECD discharge for the samples examined. The appearance of that damage also confirms that more energy was delivered for longer discharge durations. Analyses methods based on the aforementioned findings assist in determining the ECD discharge duration. However, some sample preparation may be needed to access the evidence without disturbing it, such as the removal of the probe bottom.

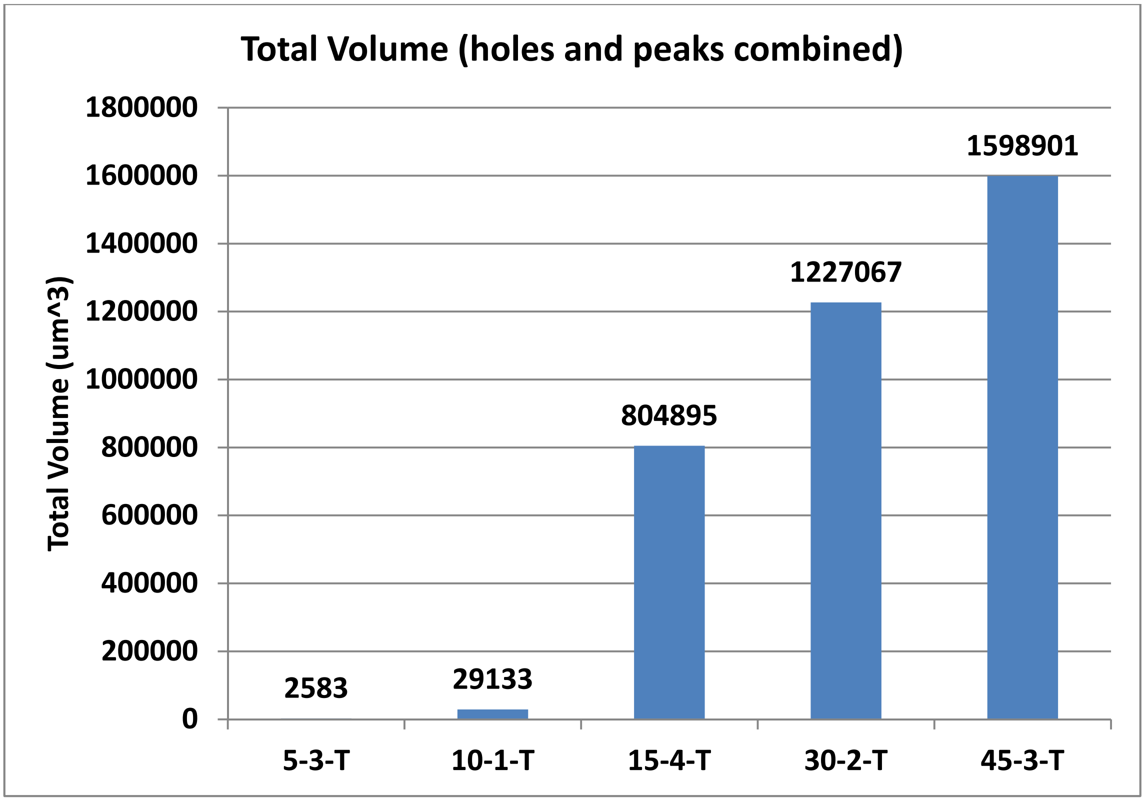

Figure 19. Surface profilometry volume measurements of the holes and peaks over the area identified to have sustained arcing damage. The first one or two positions in the sample label indicate the duration of ECD discharge.

Inspection of the Metal Probes from the Subject Piskura ECD

I have inspected both metal probes (labeled probe A and probe B) that were reportedly retrieved from the Piskura incident scene. The wires were delivered in seven (7) separated portions of varying lengths approximately 4, 1, 0.1, 20, 13, 5, and 6 feet. The cumulative wire length of the available wire portions, approximately forty-nine (49) feet, is reasonably similar to the cartridge specified wire length of fifty (50) feet. Probe A still contained the wire knot while probe B did not. While attempting to extract the wire contained in probe A it was discovered that the wire was loosely attached to the probe, which resulted in the wire dropping out of the transverse hole with minimal external force acting on it. It was also discovered that only a fraction of the wire at the opposite end from the knot penetrated the small longitudinal hole at its intersection with the larger transverse hole. This indicates that the wire had been removed prior to my inspection and could not be returned completely to its original location. The wire knot extracted from probe A appeared loose and larger than a typical knot observed in exemplar samples that I have

previously analyzed. In addition, the end of the wire at the knot from probe A appeared smeared consistent with contact with tweezers or similar extraction tool. At this time, it is unknown if any other end of the remaining separated wire portions was attached directly to probe B and if the knot that was contained in the transverse hole of probe B was untied at some point in time before I was able to review the evidence.

All thirteen wire ends were labeled and documented photographically (APPENDIX A of this report contains all the wire end images). The Piskura ECD TASER Cam video that captured part of the subject incident indicates that Mr. Piskura was rolling and thereby getting entangled with wires, which could have resulted in wire breakage. The inspected wire broken ends indicate that wire portions were in some instances cut and in some instances pulled apart. Along with the knotted wire end, there were six (6) wire ends that exhibited tensile failure (i.e. pulled apart), and six (6) wire ends that were cut. While the cut wire portions have flat ends with insulation and wire in the same plane, as shown in Figure 20, the pulled wire exhibits lengthened insulation material that under an external force has stretched more than the metal wire and had extended past the wire end, Figure 21. In the latter case, the tip of the metal wire was contained within the insulation. Such containment prevented subsequent direct contact with the bare metal wire and created an air gap between the wire tip and the end of the stretched insulation. Consequently, the wire could have only become a part of an electrical circuit, capable of delivering an electrical charge to the subject, if the electricity bridged this air gap through arcing. As mentioned before, such arcing would result in visible changes to the insulation and the wire. None of the inspected wires with extended insulation past the metal wire tip had visible witness marks that could be attributed to arcing. The absence of such witness marks indicates that the wire tips on the available wire portions did not conduct electricity after being pulled apart.

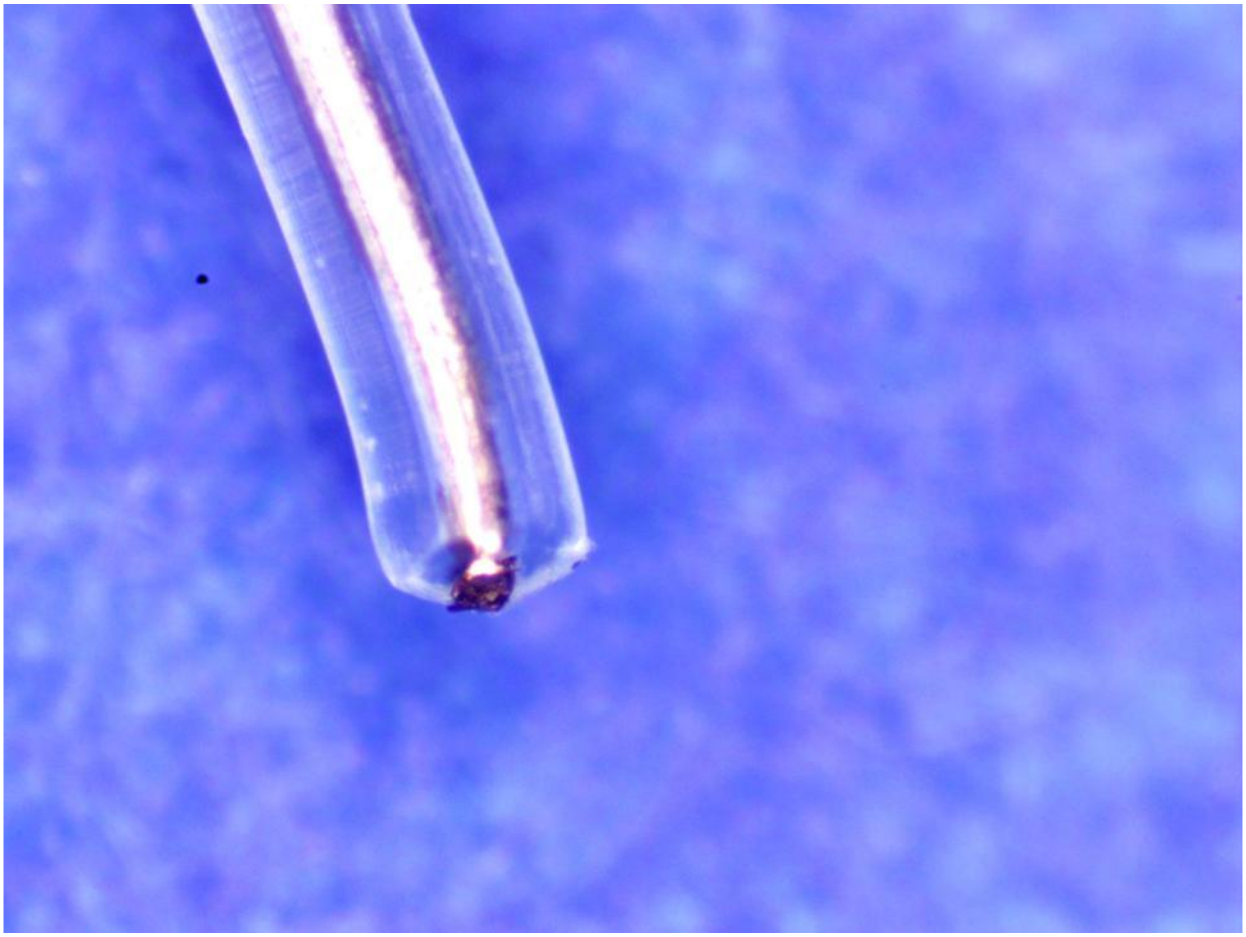

Figure 20. Wire end number 8. Note that the insulation and the wire are approximately in the same plane, indicating that the wire had been cut.

Figure 21. Wire broken end number 9. The insulation is extended past the wire tip thereby completely containing the wire and preventing direct wire contact.

Both metal probes were inspected using optical microscopy as well as SEM. The probes did not contain tissue of any kind at the time of my inspection. Furthermore, no evidence, such as arcing witness marks inside the transverse hole of the probes where the wire rests, was found to indicate that electrical current had been flowing through both probes. Figure 22 and Figure 23 show the typical appearance of the transverse hole surface of probes A and B. Machine marks, resulting from drilling operation, are visible on both probes, indicating that the surface morphology has not changed since the probes were manufactured. Dark spots in the images are shadows created by the microscope and do not reflect changes in surface morphology. For comparison purposes, Figure 24 shows the appearance of the transverse hole surface of another probe with arcing damage. It is obvious that neither of the subject probes exhibited similar damage. In the absence of evidence indicating electrical arcing inside the transverse hole on

either or both probes, removal of the bottom of the probes would not have provided additional information and therefore this was not performed.

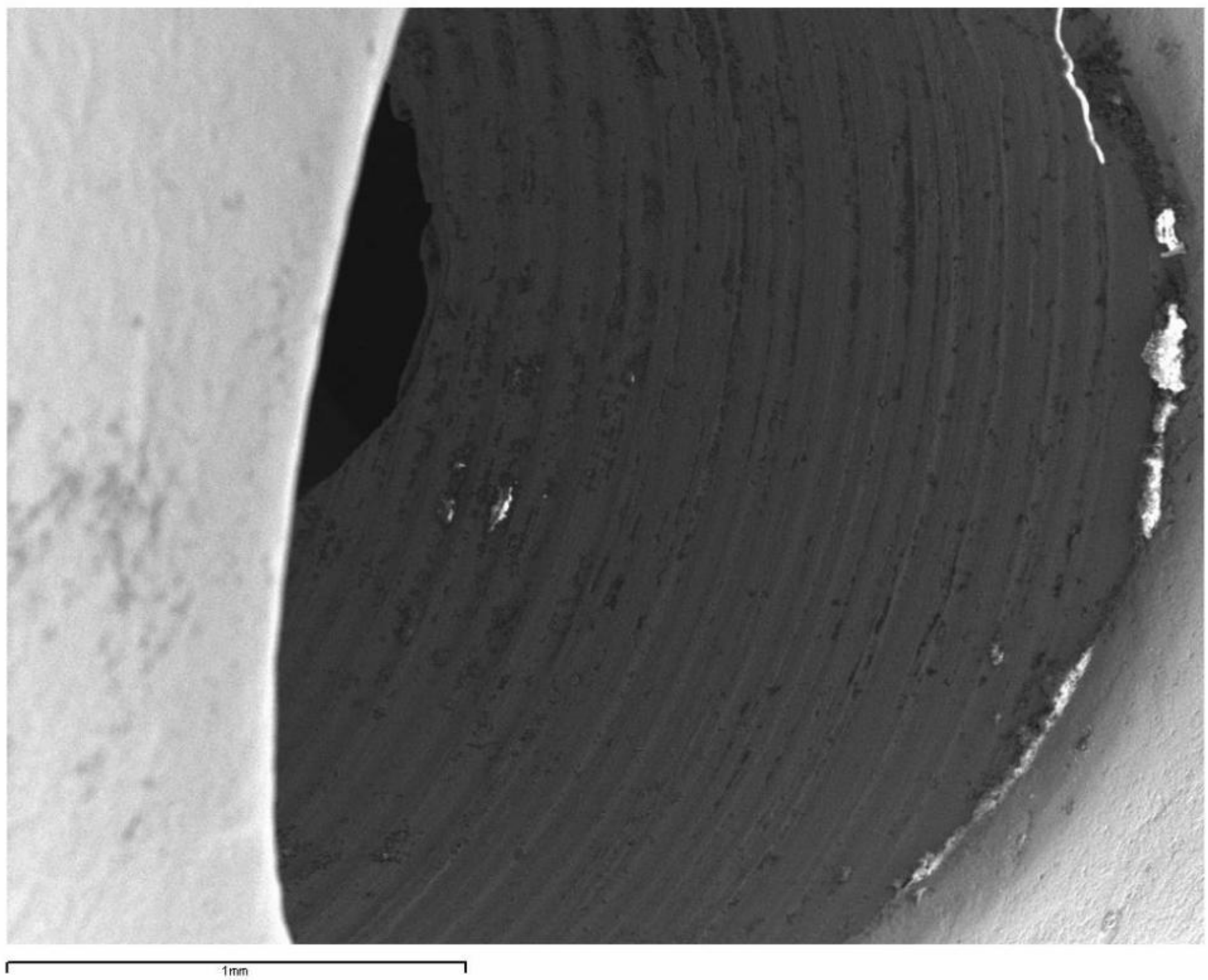

Figure 22. Typical surface appearance inside the transverse hole of Probe A at 12 o'clock. Only machining marks were observed. No disruption of material was observed consistent with arcing damage. The bright areas are nonconductive contamination.

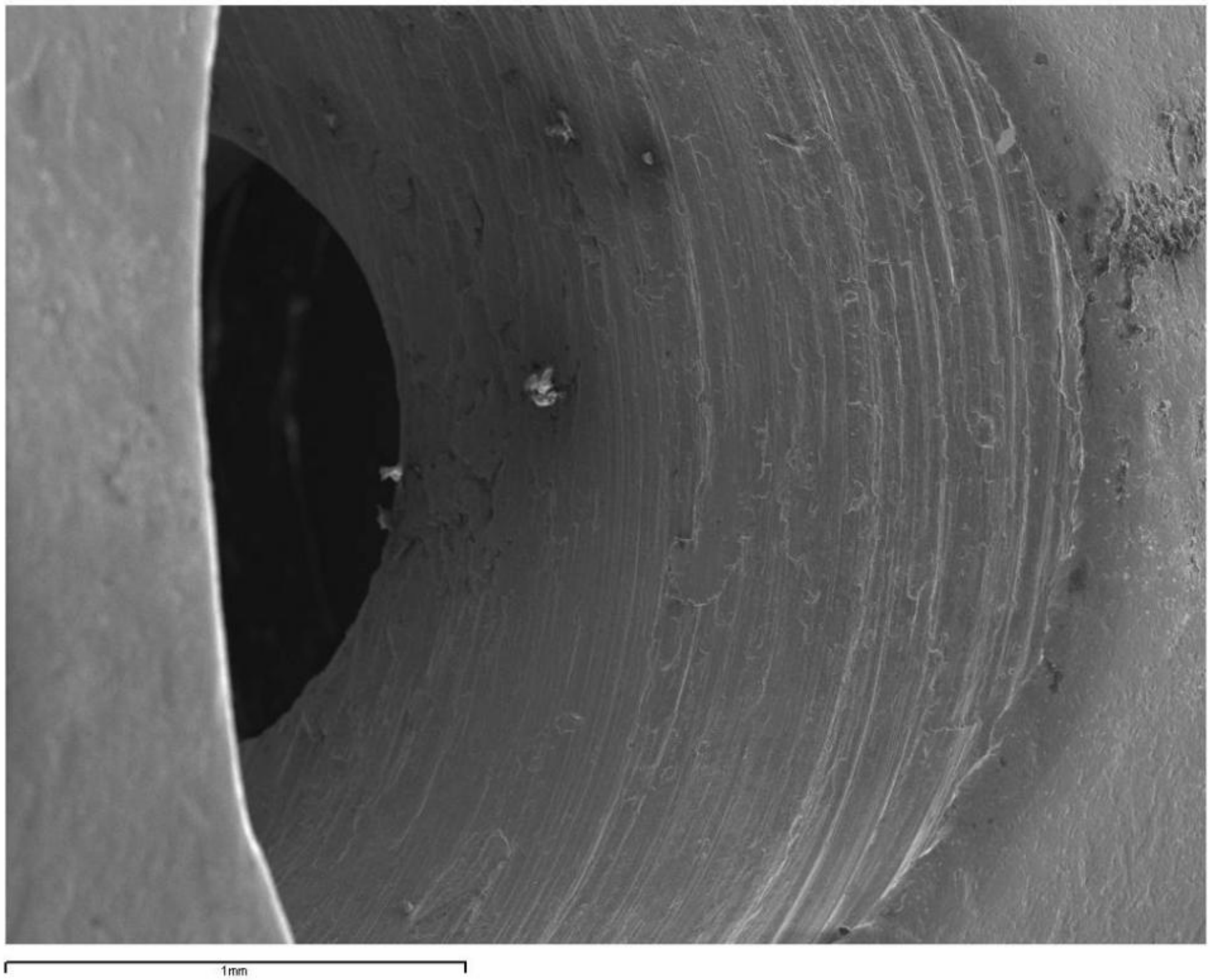

Figure 23. Typical surface appearance inside the transverse hole of Probe B at 12 o'clock. Only machining marks were observed. No disruption of material was observed consistent with arcing damage (i.e., no cratering, no deposition of material into peaks). The bright areas are nonconductive contamination.

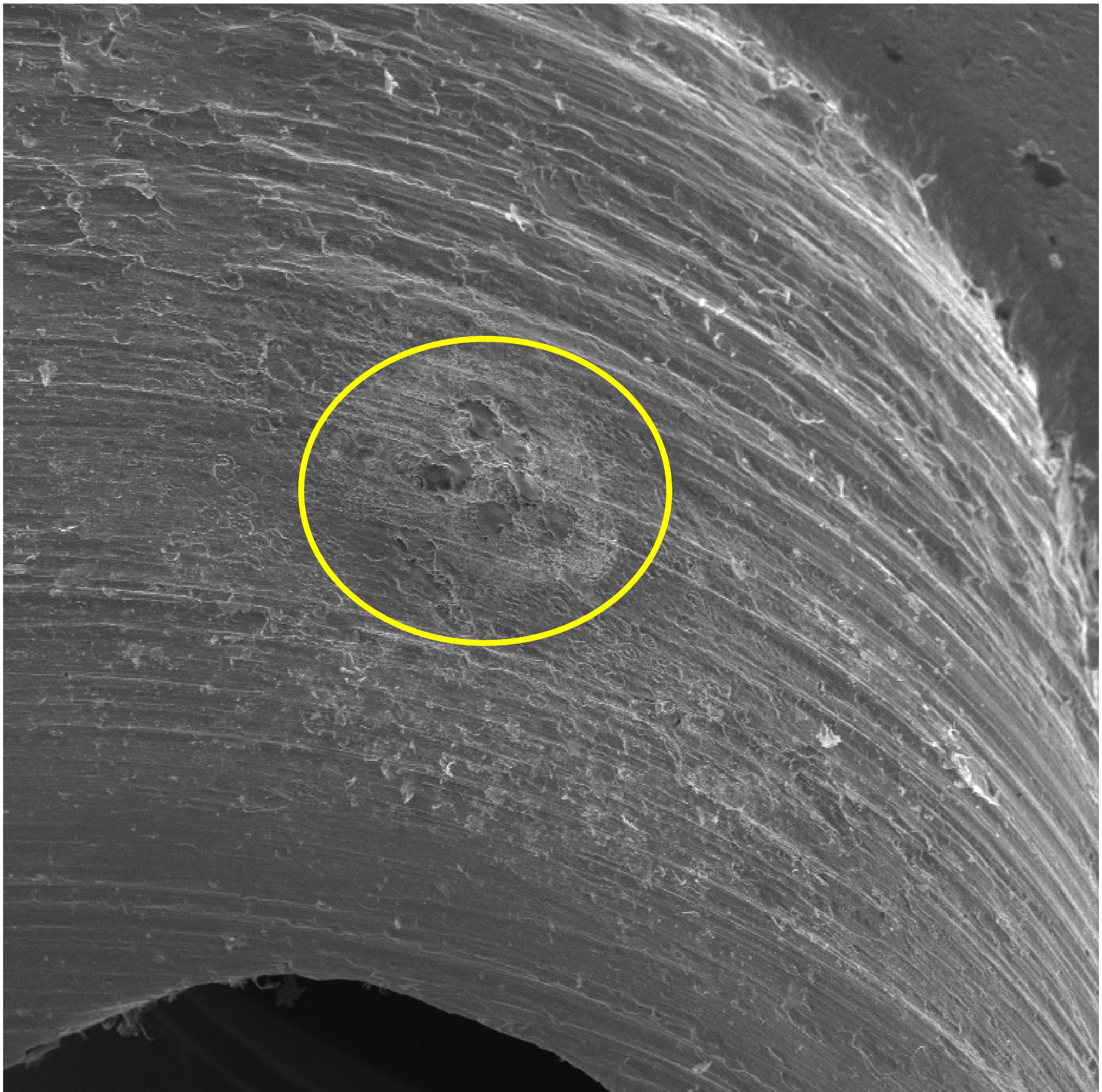

Figure 24. Typical surface appearance inside the transverse hole of a probe subjected to arcing for 10 seconds (12 o'clock).

Opinions of Darko Babic

Based upon my education, training, and experience in the areas of mechanical-material engineering, my testing, and the materials reviewed to date, I have reached the following opinions and hold each of them to a reasonable, or higher, degree of engineering certainty and/or probability.

1. Typically, forensic analysis of a single probe would be sufficient to determine the duration of an ECD discharge. Based on the forensic evaluation of both probes in the Piskura case, the attempted TASER X26 ECD discharge administered by Officer Robinson to Mr. Piskura did not include both probes. As a result, the electrical circuit was not completed through the wires and probes and Mr. Piskura never received an ECD discharge.

2. Witness marks on Mr. Piskura's body indicate that one of the probes may have contacted his chest.

3. There is no reliable evidence that the second probe contacted or struck Mr. Piskura's body.

4. Based on the wire testing Mr. Piskura could have fractured one or both wires during his body movements.

5. If either of the two wires attached to the probes becomes fractured or cut, even at a single location prior to creation of an electrical circuit through a subject's body, and the newly created wire ends do not exhibit arcing damage the electrical circuit was likely never established and the discharge through the probes never occurred. None of the twelve (12) examined wire ends exhibited evidence of arcing in this case, which, coupled with probe analysis, indicates that they were not part of an electrical circuit capable of delivering ECD discharge to Mr. Piskura.

6. Wire fractured under tensile conditions would remain contained within the stretched insulation, thereby preventing direct contact between the subject and the metal wire ends. This also creates an air gap that would have to be bridged through electrical arcing if the wire were to complete an electrical circuit. Thus, an electrical circuit with fractured wires could not have been established through the body of Mr. Piskura without creating visible evidence due to arcing between the wire tip and a contact point. Absence of such evidence on six (6) fractured wire ends examined, coupled with probe analysis, indicates that Mr. Piskura never received the attempted ECD discharge.

7. There is no evidence or reports to indicate that Mr. Piskura had cut wires while rolling over them or at any point during an attempted TASER X26 ECD discharge in probe mode by Officer Robinson. This, coupled with probe analysis and the absence of arcing damage at the six (6) cut wire ends, indicates that the wires were cut some time after the ECD discharge. Thus, there is no basis to conclude that Mr. Piskura came into contact with any of the cut wires and thereby established an electrical circuit capable of delivering ECD discharge to his body.

8. The initiation of the ECD electrical circuit never occurred, either because one of the probes missed Mr. Piskura, or because it got entangled in Mr. Piskura's clothing without striking him, or because subsequently the probe did not come into a sufficiently close proximity to his body to close the electrical circuit before one or both wires fractured as a result of Mr. Piskura's body movement, all of which prevented ECD discharge delivery to his body.

The foregoing opinions and conclusions are based on the information available to me at this time. I reserve the right to consider any information that may become available at a later date, and, if necessary, author a supplemental report.

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9. Wyant R, Hinz A. Examination of Electronic Control Device Probes to Determine Duration of Application American Academy of Forensic Science Scientific Assembly February 2009.

Appendix A

Figure 25. Appearance of wire end number 1.

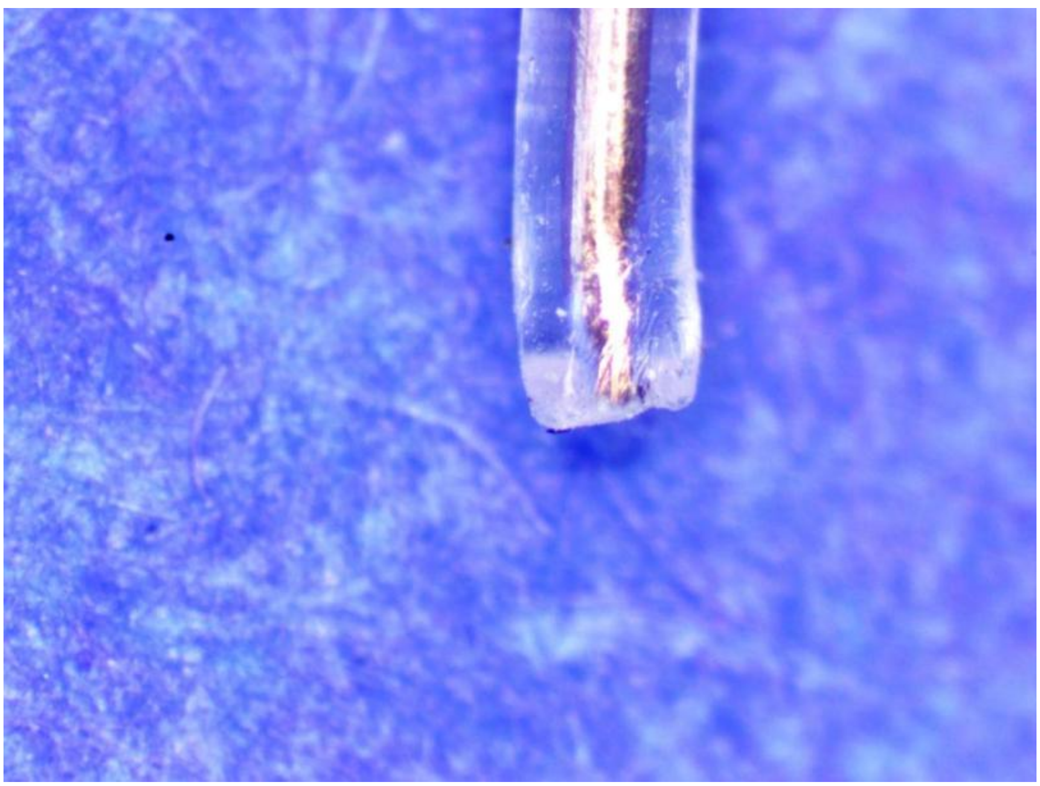

Figure 26. Appearance of wire end number 2.

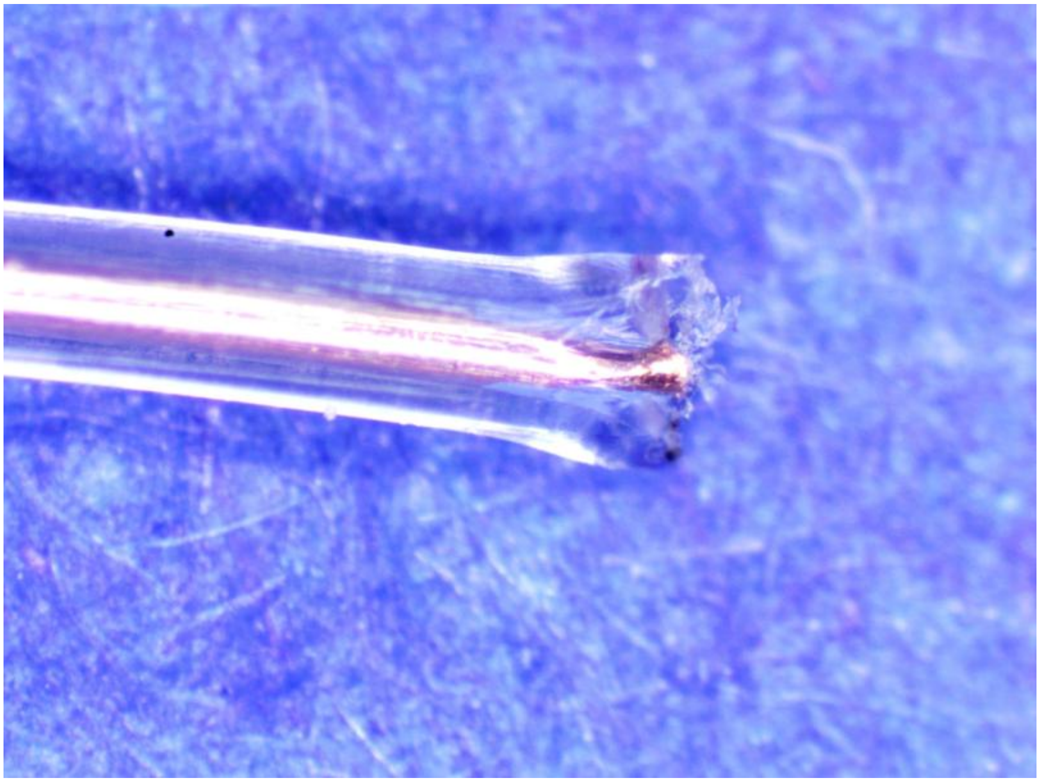

Figure 27. Appearance of wire end number 3.

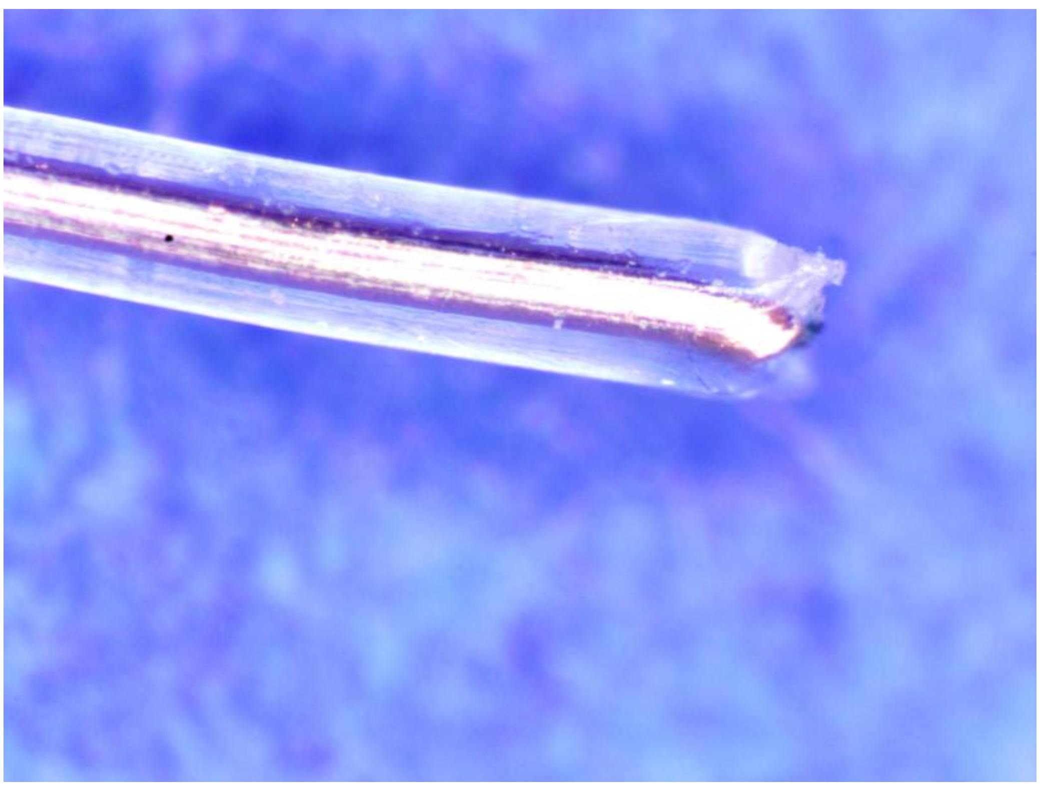

Figure 28. Appearance of wire end number 4 – opposite end from the knot.

Figure 29. Appearance of wire end number 4 – knot end.

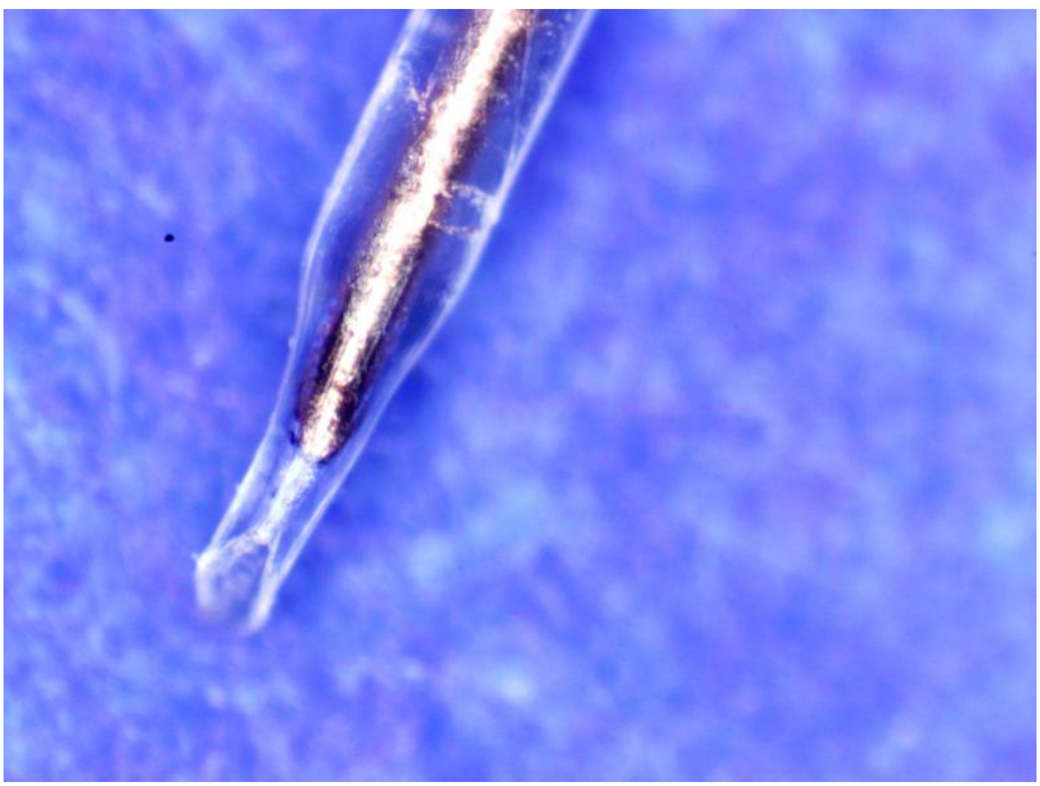

Figure 30. Appearance of wire end number 5.

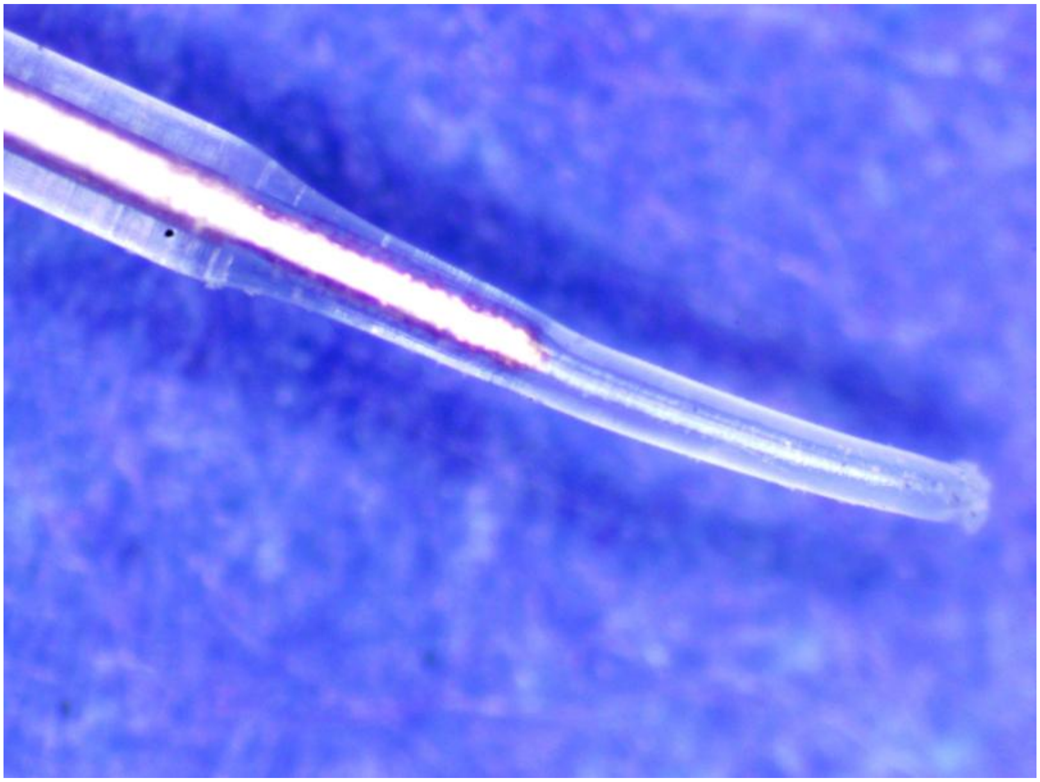

Figure 31. Appearance of wire end number 6.

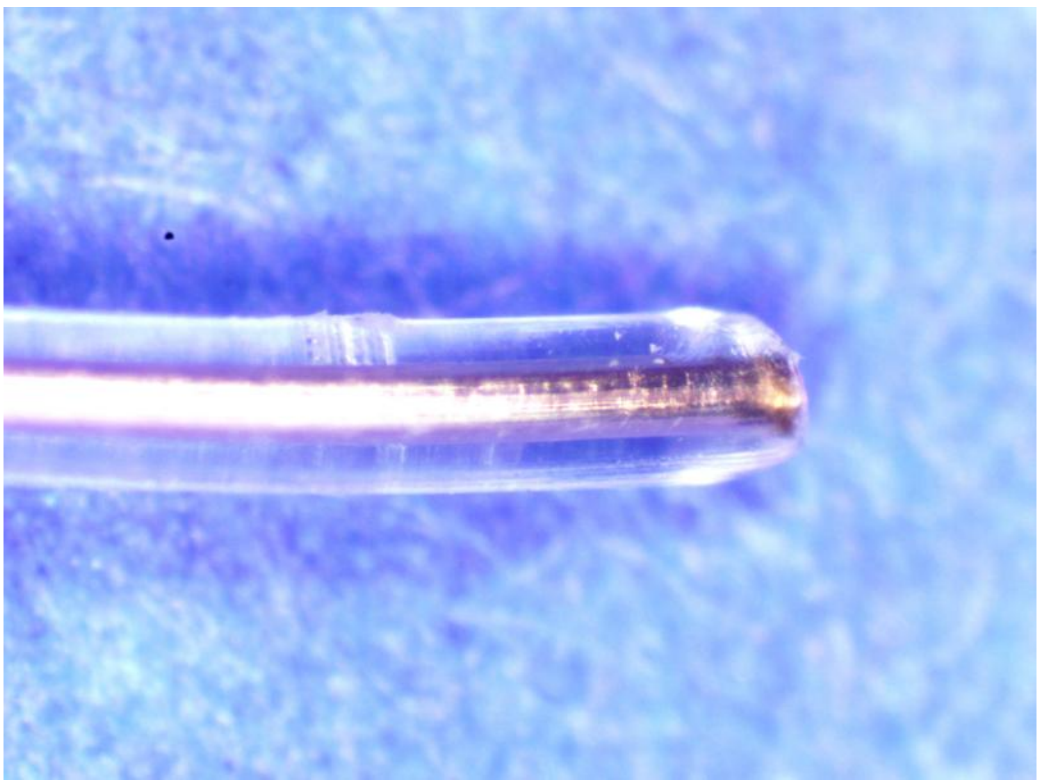

Figure 32. Appearance of wire end number 7.

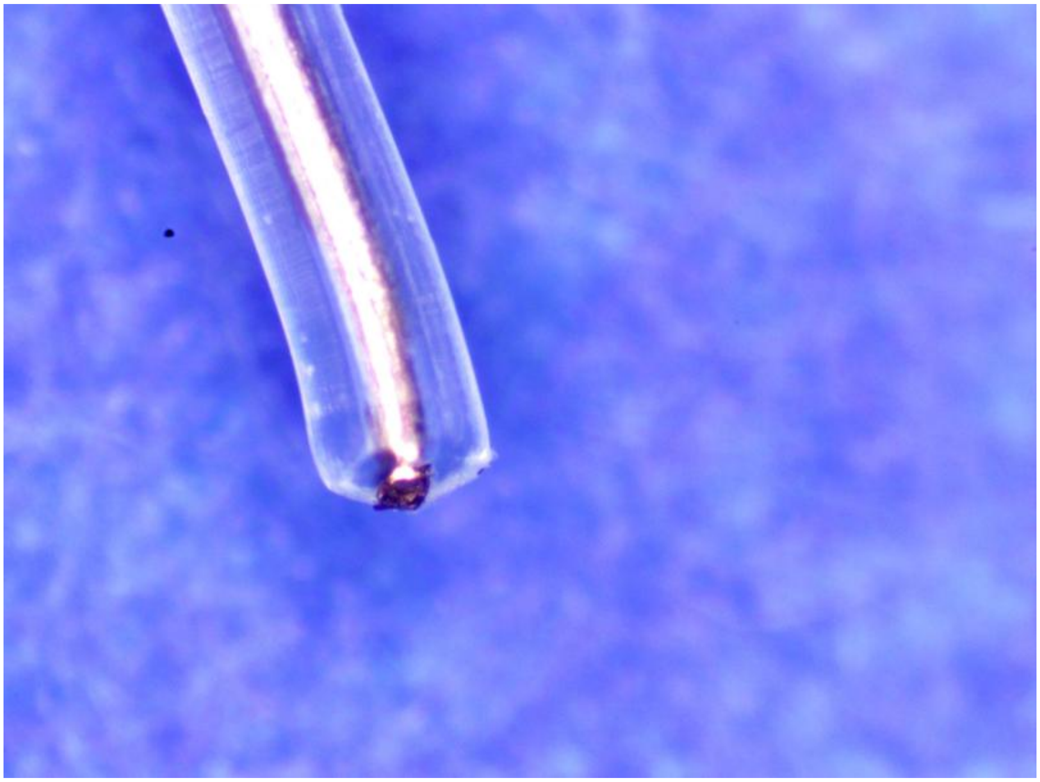

Figure 33. Appearance of wire end number 8.

Figure 34. Appearance of wire end number 9.

Figure 35. Appearance of wire end number 10.

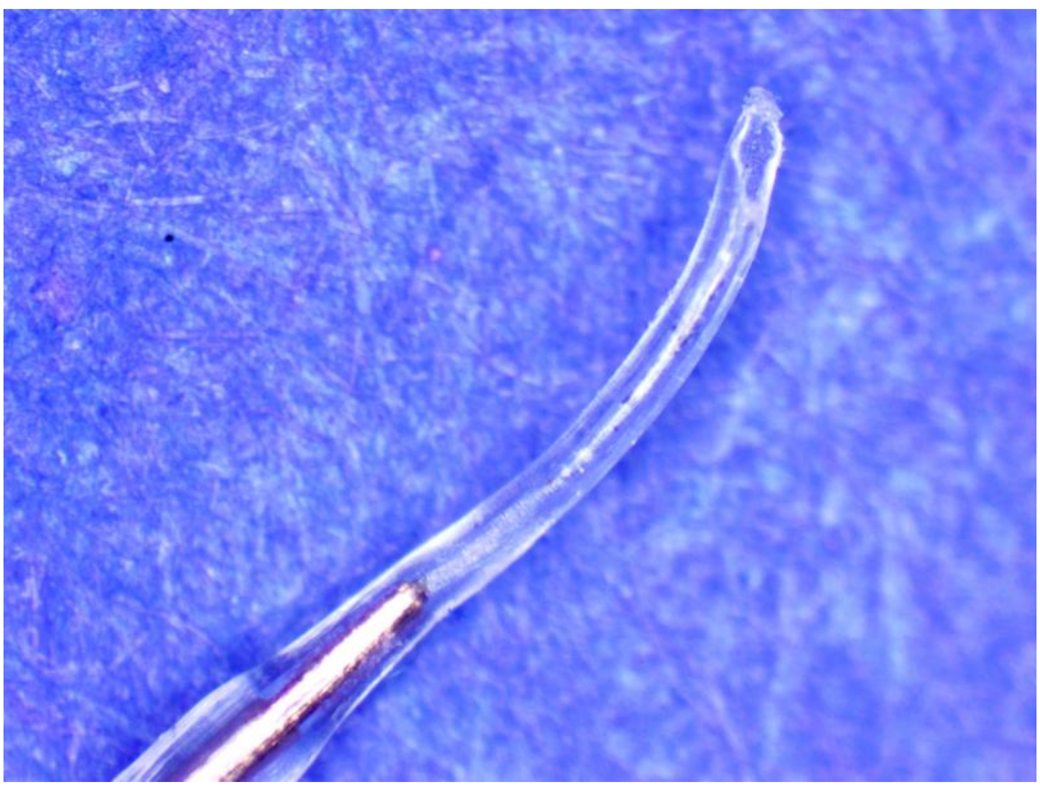

Figure 36. Appearance of wire end number 11.

Figure 37. Appearance of wire end number 12.

Appendix B

Exponent®
Failure Analysis Associates®

Darko Babic, M.S.
Manager

Professional Profile

Mr. Babic is a Manager in Exponent's Mechanical Engineering practice. He specializes in mechanical design, accident reconstruction, and failure analysis. Mr. Babic performs corrosion, fatigue, and fracture mechanics analyses of mechanical and electro-mechanical systems and components, as well as full-scale and laboratory testing, instrumentation, and data acquisition. Mr. Babic is experienced in metallurgical and polymer failure analyses using macroscopic and microscopic techniques for fracture surface and microstructure characterization. He makes extensive use of finite element modeling to evaluate structural, thermal, and fluid behavior.

He has extensive experience investigating and solving complex multidisciplinary problems in: heavy machinery and equipment (e.g. aerial lifts, forklifts, cranes, balers, pipe and rebar benders), industrial systems (e.g. refineries, boilers, pressure vessels, pipe and plumbing components, valves, gas and steam turbine components, steel and wooden structures), and consumer products (e.g. cribs, baby carriers, chairs and tables, smart phones, adapters, chargers, routers, heaters, reverse osmosis systems). These are typically related to root cause investigations or product recall. Within those investigations he has performed analysis of mechanical, hydraulic, electrical, and control systems.

Mr. Babic has performed research in the behavior of materials including: surface morphology changes as a result of electrical arcing, characterization of wheel attachments to vehicles (lug nuts, wheels and hubs), powder metallurgy alloys, sintered material analysis, material and fracture surface characterization, material imperfection analysis, fatigue of materials, and stress corrosion cracking and environmentally assisted cracking.

Prior to joining Exponent, Mr. Babic evaluated and developed enabling technologies in semiconductor manufacturing such as supercritical carbon dioxide cleaning methods and atomic layer deposition. He is experienced in clean room protocols and safety procedures. Mr. Babic is also experienced in vehicle design, testing, and analysis. He has participated in a racecar series and has direct experience with race preparation, vehicle systems, dynamics, and mechanics. Mr. Babic is currently completing his Ph.D. in Mechanical Engineering, at Arizona State University, with an emphasis on fatigue crack nucleation and propagation.

Credentials and Professional Honors

M.S., Materials Science and Engineering, Arizona State University
B.S., Mechanical Engineering, Arizona State University *(magna cum laude)*

Peer Reviewed for
- *Journal of Testing and Evaluation*
- Society of Automotive Engineers (SAE) World Congress

American Society of Mechanical Engineers
- Member of Committee for High Pressure Piping Code B31.3

American Society of Materials
- Former Arizona Chapter Chair

Arizona State Regents Scholarship, awarded to international students with the highest academic merit (1998–2000); Dean's Honor List (1996–2000); Tau Beta Pi National Honor Society Pi Tau Sigma;

Patents

US20060065189A1 & WO2006039314A1: Method and system for homogenization of supercritical fluid in a high pressure processing system.

US20060065288A1 & WO2006039317A1: Supercritical fluid processing system having a coating on internal members and a method of using.

US20060065636A1: Method and system for controlling a velocity field of a supercritical fluid in a processing system.

US20060070640A1 & WO2006039321A1: Method and system for injecting chemistry into a supercritical fluid.

US20060130966A1: Method and system for flowing a supercritical fluid in a high pressure processing system.

US20060134332A1: Precompressed coating of internal members in a supercritical fluid processing system.

US20060266289A1 & WO2006078666A2: Reaction system for growing a thin film.

Publications

Babic D, Chawla N, Williams JJ, Polasik SJ, Marucci M, Narasimhan KS. Effect of copper and nickel alloying additions on the tensile and fatigue behavior of sintered steels. Advances in Powder Metallurgy and Particulate Materials 2002; 5:104–112.

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Wu L, Xu Y, Wang F-Y, Lin YT, Li PZ, Liu WJ, Mirchandani PB, Babic D, Kuo CY. Supervised learning of longitudinal driving behavior for intelligent vehicles using neuro-fuzzy

networks: Initial experimental results. International Journal of Intelligent Control and Systems 1999; 3:443–463.

Selected Presentations

Babic D, Arora, A., Martens, J. AC & DC Adapter Safety Considerations, Presentation, 2011 IEEE Symposium on Product Compliance Engineering, IEEE Product Safety Engineering Society (PSES), San Diego, CA, 2011.

Babic, D. Finite Element Analysis as a Part of Failure Analysis, Constitutive Modeling, Non-linear Behavior. Failure Analysis Class Lectures at Arizona State University, 2011.

Babic D, Arora, A. Expected Environmental Conditions in Automotive Applications – Temperature Distribution in a Polymeric Dash Board, Presentation, 2009 IEEE Symposium on Product Compliance Engineering, IEEE Product Safety Engineering Society (PSES), Toronto, Canada, 2009.

Babic D, Chawla N, Williams JJ, Polasik SJ, Marucci M, Narasimhan KS. Effect of Copper and Nickel Alloying Additions on the Tensile and Fatigue Behavior of Sintered Steels. World Congress for Powder Metallurgy and Particulate Materials, Orlando, FL, 2002.

Professional Affiliations

- American Academy of Forensics Sciences – Member
- ASM International (Former Arizona Chapter Chair)
- American Society of Mechanical Engineers
    - Committee for High Pressure Piping Code B31.3, Task Group H – High Pressure Ultra High Purity Systems – Former Member
- Semiconductor Equipment and Materials International (SEMI), Former Contributing Member to the High Pressure Task Force
- Society of Automotive Engineers
- ASME – FIRST Robotics Competition Mentoring Program

Appendix C

Darko Babic M.S.

Trial and Deposition Testimony

March 14, 2006	***Galan v Navistar International*** Deposition In the District Court of Hidalgo Co., TX No. C-1301-05-D
October 4, 2006	***State Farm (Oskner) v CranePlumbing, L.L.C.*** Arbitration In the Superior Court of the State of Arizona in and for the County of Maricopa No. CV2005-053676
May 25, 2007	***Ochenhirt v Nordic Boats*** Trial In the Superior Court of the State of Arizona in and for the County of Mohave No. CV2005-001193
July 25, 2007	***White v Trimas Hammerblow*** Deposition In the Superior Court of the State of Arizona in and for the County of Maricopa No. CV2005-90733
December 17, 2007	***API Outdoors Inc. v American Cord and Webbing Co. Inc.*** Deposition In the Circuit Court of Jackson County, Missouri at Kansas City No. 03CV215842
December 15, 2008	***Topete v Lifetime Fitness, Inc.*** Deposition In the Superior Court of the State of Arizona in and for the County of Maricopa No. CV2007-004955
January 20, 2009	***Labno v Graco Children's Products Inc.*** Deposition In the Superior Court of the State of Arizona in and for the County of Maricopa No. CV2007-016925

May 25, 2011	***Garcia v KRB Machinery*** Mediation In the Superior Court of the State of Arizona in and for the County of Maricopa No. CV2009-015935
October 6, 2011	***Baker Commodities v Southgate Engineering*** Mediation